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P. 264 "In the campaign of last year (1812)"

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THE

EDINBURGH ENCYCLOPÆDIA;

CONDUCTED BY

DAVID BREWSTER, LL.D.

F. R. S. LOND. AND EDIN. AND M. R. I. A.

CORRESPONDING MEMBER OF THE ROYAL ACADEMY OF SCIENCES OF PARIS, AND OF THE ROYAL ACADEMY OF SCIENCES OF PRUSSIA; MEMBER OF THE ROYAL SWEDISH ACADEMY OF SCIENCES; OF THE ROYAL SOCIETY OF SCIENCES OF DENMARK; OF THE ROYAL SOCIETY OF GOTTINGEN, AND OF THE ROYAL ACADEMY OF SCIENCES OF MODENA; HONORARY ASSOCIATE OF THE ROYAL ACADEMY OF SCIENCES OF LYONS; ASSOCIATE OF THE SOCIETY OF CIVIL ENGINEERS; MEMBER OF THE SOCIETY OF THE ANTIQUARIES OF SCOTLAND; OF THE GEOLOGICAL SOCIETY OF LONDON, AND OF THE ASTRONOMICAL SOCIETY OF LONDON; OF THE AMERICAN ANTIQUARIAN SOCIETY; HONORARY MEMBER OF THE LITERARY AND PHILOSOPHICAL SOCIETY OF NEW YORK, OF THE HISTORICAL SOCIETY OF NEW YORK; OF THE LITERARY AND PHILOSOPHICAL SOCIETY OF UTRECHT; OF THE PHILOSOPHICAL SOCIETY OF CAMBRIDGE; OF THE LITERARY AND ANTIQUARIAN SOCIETY OF PERTH: OF THE NORTHERN INSTITUTION, AND OF THE ROYAL MEDICAL AND PHYSICAL SOCIETIES OF EDINBURGH; OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA; OF THE SOCIETY OF THE FRIENDS OF NATURAL HISTORY OF BERLIN; OF THE NATURAL HISTORY SOCIETY OF FRANKFORT; OF THE PHILOSOPHICAL AND LITERARY SOCIETY OF LEEDS, OF THE ROYAL GEOLOGICAL SOCIETY OF CORNWALL, AND OF THE PHILOSOPHICAL SOCIETY OF YORK.

WITH THE ASSISTANCE OF

GENTLEMEN EMINENT IN SCIENCE AND LITERATURE.

IN EIGHTEEN VOLUMES.

VOLUME VII.

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THE

EDINBURGH ENCYCLOPÆDIA.

COLUMBUS, or Colon, Christopher, the well-known discoverer of America. He was a citizen of the republic of Genoa, and born in the year 1447. The exact place of his birth has not been ascertained;* and it is only by inference from certain statements made by Columbus himself, in the letters which he addressed to Ferdinand and Isabella, the rulers of Spain, that the date of his nativity has been obtained with any measure of correctness. These letters are preserved in the life of the Genoese navigator, written by Don Ferdinand his son. In one of them Columbus informs the exalted persons to whom he addressed himself, that at the time he wrote A. D. 1501, he had been engaged nearly forty years in the profession and life of a seaman; and in another letter he states, that he went to sea so early as the age of fourteen. The statements in both instances are deliberately made by Columbus himself; there is no reason therefore to doubt their accuracy, or to dispute the inference that this illustrious navigator was born in the year 1447.

The family from which Columbus was sprung had betaken themselves, for several generations, to a sea-faring life, and, as it appears, with very little emolument or success; for the immediate parents of the navigator seem to have been in indigent circumstances at the time of his birth. They were able, however, in one way or another, to give to Columbus such an education, as fitted him for the profession, in which, after the example of his ancestors, he was about to engage. Besides the more necessary branches, they had him instructed in geometry, astronomy, and cosmography, and in the art of drawing; in every thing, in short, which was held to be requisite or proper at that time, to form a skilful and successful adventurer upon the seas. Such an education must have been attended with considerable expence; but so little of the early life of this extraordinary man is known, that we have not the means of ascertaining how the expence was defrayed, whether by assistance of wealthy relatives, or whether the young Columbus was so fortunate as to meet with a patron, at once decerning enough to mark the indications of his genius, and able as well as willing to support him, during the prosecution of his studies.

Columbus was not one of those whose abilities remain concealed till late in life, and who, after a youth spent in idleness or vice, or sleepy stupidity, have awakened, at a more advanced age, in all the ardour and activity of genius. Having chosen his profession, he hastened to qualify himself for the honourable discharge of its duties. He is said to have imbibed the instructions of his teachers with a surprising quickness: He speedily mastered the Latin tongue, and attained to a competent knowledge of geometry, astronomy, and the theory of navigation. At the age of fourteen, as we have already stated, he went to sea. He made his first voyages to those parts of the Mediterranean which were frequented by his countrymen the Genoese, trading with the inhabitants, and satisfied, as it seems, for a time, with the gains of reputable merchandise. But the ardour of his mind was not to be repressed, and a prouder career and a higher destiny awaited him. When not older than twenty, he undertook a voyage of curiosity, or rather of discovery; for so perhaps we might be permitted to call it, as one object which he had in view undoubtedly was, to ascertain whether the frigid zone was habitable. Accordingly he stretched into the northern seas, ran along a part of the coast of Iceland, the limit and extremity of former enterprises, and pushed into the ocean which lies beyond the arctic circle. "In February 1647," says he, in a memorandum upon the subject, "I sailed 100 leagues beyond Thule or Iceland, the northern part of which is 73 degrees distant from the equinoctial, and not 63 degrees as some suppose; neither does it lie upon the line where Ptolemy begins the west, but considerably more to the westward. To this island, which is as large as England, the English carry on a trade, especially from the port of Bristol. When I was there the sea was not frozen, but the tides were so great, that in some places they rose and fell 26 braccios (about 45 feet). I have likewise been in the Portuguese fort of St George del Mina, under the equinoctial, and can witness that it is not uninhabitable, as

* Before Columbus received his commission from Ferdinand and Isabella, he usually designed himself *Columbus de Terra Rubra.*

some have supposed." *Life of Columb.* Churchill's *Voyages*, vol. ii. In this voyage, the fortune of Columbus, as a merchant, was not increased in any remarkable degree, but he derived from it a large accession of skill and experience in the nautical art; and he now began, perhaps for the first time, to taste the sweets of reputation, and to know something of the inexpressible pleasure which results from the assurance of having done what no one has ever executed or even attempted before. The next adventure of Columbus which his biographers have recorded, was of a kind somewhat different. Not long after his return from the northern ocean, he appears to have entered the service of *Columbus junior*, as he was called, a famous sea-captain of those times, but in what capacity our adventurer was employed, we have not been able to learn. The officer alluded to, who was of the same family as well as of the same name with the discoverer of America, commanded a small squadron fitted out at his own expence, and carried on a piratical warfare against the Venetians and the Turks, the rivals of the Genoese at this period, in the commerce and the sovereignty of the Mediterranean. In the service of the captain just mentioned, Columbus established his character, not only for skill and dexterity in naval affairs, but also for courage. His valour was tried in many severe conflicts, and his life often exposed to danger. On one hazardous occasion in particular, he escaped with great difficulty. Having attacked, along with the rest of the fleet under the orders of his relative, some Venetian galleys which were returning, deeply and richly laden from the coast of Flanders, in the ardour of the combat, he grappled with one of the enemy's vessels, and in this situation, fast locked to his antagonist by means of strong iron hooks and chains, the ship in which he served unfortunately took fire. In a moment, all was terror, and outcry and confusion. But Columbus, distinguished as much by his coolness and presence of mind, as by his bravery in action, threw himself into the sea, and partly by swimming, and partly by the support of an oar which he found accidentally within his reach, got safe to land. This engagement took place not far from the harbour of Lisbon, and the distance between the vessel and the shore is said to have been more than two leagues.

Quitting the dangerous, and judging by our ideas of piratical warfare, the less honourable service of his relative, Columbus, as soon as his health was established, repaired to Lisbon. The encouragement given by Don Henry of Portugal, to every person at all skilled in the art of navigation, and animated with the love of discovery, was at this time exceedingly great. To Columbus, therefore, still young, ardent, enterprising and active, the service of the Portuguese appeared every way desirable. He readily yielded to the solicitations of his friends, and consented to fix his residence in Lisbon; and having about the same time married a Portuguese lady, by name Donna Felipa Moniz Perestrello, he seems to have considered himself as a regular and recognised subject of Portugal. Nor did the circumstance of his marriage either detach him altogether from sea affairs, or suppress within him the desire of honourable reputation. The lady in question was the daughter of Peter Moniz Perestrello, himself a sailor, and one who had been employed in the earlier navigations of Don Henry, and had discovered, under the license and patronage of that prince, the islands of Puerto Sancto and Madeira. In the eye of Columbus, therefore, a connection with such a family appeared not only highly reputable in itself, but likely to be of essential service to him in his future pursuits. By means of his wife, he got possession of the journals, sea-charts, and other papers which had belonged to her father Perestrello; and he easily learned from them what object the Portuguese rulers had in view in prosecuting their navigations towards the south. This object was nothing else than to discover a passage to the East Indies, in order to secure to their country the profitable commerce with the spice islands, which had hitherto been engrossed by the Venetians: And it was proposed to reach those distant parts by sailing round the continent of Africa, or at least by doubling its most southern cape.

After Columbus had made himself acquainted with these and other particulars, the thought of finding a shorter and safer passage to the East Indies, appears gradually to have arisen in his mind. In the discovery of the New World, little is to be ascribed to accident, or to any thing bearing the name and character of accident. It was the result of diligent enquiry and patient comparison; it was a conclusion attained by successive steps and profound and elaborate reflection; the legitimate issue of those rational faculties which the Almighty has implanted in man; the exclusive property, as well as the boast of our intellectual nature. The rotundity of the planet on which we live was known. Upon the authority of the ancients, an authority highly respected and valued in the 15th century, it was believed that the ocean encompassed the whole earth, and in particular that it extended in a direction from east to west, between the coast of Spain lying nearest the Atlantic, and the shores of India. Marco Polo, a noble Venetian, and other travellers of modern times, had asserted, that the countries which they had visited beyond those of Persia and India, and to which they gave the names of Cathay and Zipango, stretched out in a wonderful manner towards the east. The inference therefore was, and Columbus readily drew it, that in proportion as those countries extended towards the east, they must approach what we should now call the western longitude, or pass into it altogether; and, therefore, that to sail directly west, was the shortest as well as the most obvious and certain course, in order to reach them. This result was strengthened, in a great degree, by the errors into which the ancient geographers had fallen, with regard to the countries situated beyond the eastern limit of the Persian empire. They had placed these countries much farther from the first meridian which passed through the Fortunate Islands, than their real position. According to Marinus Tyrius, one of the most distinguished of the ancient geographers, the country of the Sinæ, or Chinese, was situated at no less a distance from the meridian alluded to, than 15 hours, or 225 degrees: And beyond the Chinese lay the kingdoms of Cathay and Zipango, extending still farther in an easterly direction. The conclusion, therefore, from the whole, seemed to be irresistible and sure, that the countries in question might be visited by sailing in a westerly course: and, moreover, that these countries would actually be found to lie within a distance, by no means considerable, from the Canary Islands, or even from the coast of Africa.

In the conclusion now mentioned, Columbus was still more firmly established, by the communications which he had with his cotemporary Paul, a physician of Florence, a man well known for his acquaintance with geometry and cosmography, and for his inquiries into the results, whether certain or only probable, which had followed from the Portuguese navigations. This learned person stated several facts in confirmation of the

Columbus. scheme suggested by Columbus, pointed out the course of sailing on a chart which he sent to the navigator, urged him strongly to secure the proper means in order to the execution of his purpose, and concluded by saying "that the voyage laid down, was not only possible, but true, certain, honourable, advantageous, and most glorious among Christians."

The next step of Columbus was to engage some of the European powers in the accomplishment of his object. But the difficulties which he experienced while soliciting at the courts of kings, the patronage which he at length obtained, the progress of the voyage, and the actual discovery of the American continent, have already been treated of in another part of this work. See AMERICA. It remains, therefore, only to add a few particulars relative to the subsequent history of the Genoese navigator.

During his return from the countries which he had visited, a severe tempest overtook the fleet, so that the life of the admiral was exposed to extreme danger. The wind, which had for many days been moderate, as well as favourable, now suddenly rose in great violence, and blew with the fury of a hurricane, while every thing which naval skill or long experience could suggest, was anxiously tried, in order to save the ships. The mind of Columbus, too, was harassed with the fear, lest all knowledge and memory of his discoveries should be for ever lost, and the human race be deprived of the advantages which he had no doubt would result from an intercourse with the inhabitants of the western world. Nor was he without a reasonable concern for his own reputation, dreading it as the worst evil that could befal him, to be handed down to posterity in the character of a bold but visionary projector, whose time had been spent, and whose life had been thrown away, in the pursuit of unattainable objects. The fury of the storm increased, and no hope of safety seemed to remain. In these circumstances, Columbus bethought himself of an expedient, most proper in itself, and every way advisable, as it must appear when once pointed out, but which perhaps would not readily have occurred to any one possessed of less composure and presence of mind. He instantly retired to his cabin, and wrote upon parchment a short account of his voyage and of his success. This writing he folded up and sealed, addressing it to their Majesties the King and Queen of Spain; and having ordered a large cask to be brought to him, he wrapt the parchment in oiled cloth, surrounded it on all sides with wax, and inclosed it in the cask: and carefully stopping up this last, he threw the whole into the sea. Nor was he satisfied with one packet of the kind which we have just described; he immediately prepared another similar to the first, and attached it to the poop of the vessel, that, as he expresses it himself "when the ship sunk, the cask might float upon the water, and take its chance of being found." *Life of Columbus*, Churchill's *Voyages*, vol. ii. Happily, however, the storm at length abated; and not many days after, Columbus entered the port of Palos, from which he had sailed about seven months before, amidst the acclamations and the wonder of the multitude, who had perceived the vessel at a distance, and who waited his approach.

The commission under which Columbus agreed to undertake the voyage of discovery, invested him with high powers, and secured to him many important privileges. From the beginning he had stipulated, "That he should be admiral on the ocean of all the seas and lands which he might discover, with all the allowances, privileges, and prerogatives enjoyed by the admirals of Castile and Leon, in their several seas: That all civil employments, as well of government as in the administration of justice, should be entirely at his disposal, in all the islands and continents which he was to discover: That all governments should be given to one of three persons to be named by him; and that he should appoint judges in all parts of Spain trading to the Indies, to decide upon all causes relating to that trade and to those parts." These conditions, and others, which our limits prevent us from stating, were the more readily agreed to by Ferdinand and Isabella, while the scheme of Columbus remained as a matter of speculation, and before the discovery of the western continent was actually made. But no sooner was it ascertained, that countries hitherto unknown had really been visited, and occupied in the name of the Spanish monarchy, than it was perceived that the commission was too ample, and the powers and privileges too many and great. Such a commission, however, had been granted, and it could not openly or immediately be revoked. The mind of Ferdinand, though cultivated in some degree, was neither strong nor comprehensive. His temper was suspicious and peevish; and unfortunately, his ear was open to the insinuations of the enemies of Columbus. Less gold had been obtained from the countries newly occupied, than the avarice of the monarch had led him to expect. Indeed the conquests actually made, had never defrayed the expense of securing and maintaining them. Disturbances likewise had arisen in the colony of Hispaniola; and though these disturbances had been quelled by the presence of Columbus and by powerful aid from Europe, still the very existence of such disturbances, lessened, in the mind of Ferdinand, the hope of undeviating prosperity, which he had universally permitted himself to entertain, and rendered his temper yet more suspicious and fretful. Complaints of the misrule of Columbus were daily brought to him; and in the moment of irritation, this capricious monarch, granted a commission to Francis de Bovadilla, a knight of the order of Calatrava, empowering him to proceed to Hispaniola, to inquire into the conduct of the admiral, and upon finding him guilty, or even upon finding any plausible reason for a charge against him, to take upon himself the government of the island. The result was exactly what might have been expected, from a commission so utterly preposterous and unjust. Materials for a charge against Columbus were collected; every sort of information, even from persons the most infamous, was greedily received, and the admiral, now advanced in years but still unbroken in spirit, was loaded with irons, and hurried on board a ship. The charge was then drawn up according to the forms of law; and the discoverer of the western world was sent to Europe, in order to be tried for his offences, real or supposed, by the government at home.

It is not easy to read the account of this infamous proceeding with any measure of patience. It was not believed, even by the tyrannical Bovadilla himself, that Columbus had abused, in any one respect, the authority or the privileges of the situation in which his sovereign had placed him. His life, as a subject of the Spanish crown, was that of uniform obedience and unwearied activity. And his whole conduct was such as to gain, not only the esteem, but the enthusiastic admiration and praise of every one who had the opportunity and the means of becoming acquainted with it. In consequence of this opinion and belief, Alonzo de Vallejo, the captain of the vessel on board of which Columbus was confined, Columbus. approached his prisoner, immediately after they had quitted the island, with feelings of the highest veneration and the deepest regret, and offered to release him from the fetters with which he was bound. "No," said Columbus, in a burst of generous indignation, "I wear those irons in consequence of an order from their majesties the rulers of Spain. They shall find me as obedient to this, as to their other injunctions. By their command I have been confined, and their command alone shall set me at liberty." He never forgot the unjust and shameful treatment which he had received. Through the whole of his after life he carried the fetters with him wherever he went, as a memorial of the ingratitude of his country: he hung them up in his chamber, and at last gave orders that they should be buried with him in his grave.

Upon the arrival of Columbus in Spain, a prisoner and in fetters, the indignation of all men was highly excited, and Ferdinand himself, cold and distant and haughty as he was, felt, for a while, the emotions of shame. He ordered Columbus into his presence, disclaimed all knowledge of his imprisonment, and soothed him with kind words and promises. But after detaining him at court for a long time in fatiguing attendance and fruitless solicitation, he appointed Nicholas de Ovando, a knight of the order of Alcantara, governor of Hispaniola in his stead. Such was the reward which Columbus received, for having devised and carried on to a successful issue, the most noble enterprise which has ever entered into the mind of man; and such is the account which impartial history is constrained to give of the justice and the gratitude of kings!

But though unwilling to restore Columbus to his place and the honours connected with it, Ferdinand and Isabella were still desirous to employ him in new enterprises by sea. He made in all four voyages to the western continent. He discovered the main land of America, and sailed along the coast from Cape Gracios a Dios to the harbour of Portobello. It was in the neighbourhood of the place last mentioned, that he gained, for a time, an astonishing command over the Indians by predicting an eclipse of the moon. At length, after a considerable variety of fortune, he returned to Spain; and worn out with many years, and fatigue, and disappointment, and sorrow, he died at Valladolid, on the 20th of May, 1506. His funeral, by the orders of Philip, who ascended about this time the throne of Castile, was extremely magnificent, and the following inscription was engraven upon his tomb:

A CASTILIA YA LEON
NUEVO MUNDO, DIO COLON.

Columbus || Comedy.

See Herrera's *Gen. Hist.* dec. 1. lib. iv. c. 7; *Life of Columbus*, Churchill's *Voyages*, vol. ii.; Aikin's *Biographical Dictionary*, article *Columbus*; and Robertson's *America*, vol. 1. (*h*)

COLUMELLIA. See BOTANY, p. 92, 300.

COLUMN. See CIVIL ARCHITECTURE.

COLUMNEA, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 250.

COLURES. See GEOGRAPHY.

COLUTEA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 276.

COMA BERENICE'S. See ASTRONOMY, p. 750.

COMARUM, a genus of plants of the class Icosandria, and order Polygynia. See BOTANY, p. 232.

COMASPERMUM, a genus of plants of the class Diadelphia, and order Octandria. See BOTANY, p. 285.

COMBRETUM, a genus of plants of the class Octandria, and order Monogynia. See BOTANY, p. 199.

COMBUSTION. See BURNING INSTRUMENTS, and CHEMISTRY.

COMEDY. See DRAMA.

COMETS.

Comets. IN the article ASTRONOMY, Vol. II. pp. 674, 695, 814, we have already treated of the subject of comets, and we shall now lay before our readers such further information as may appear necessary upon this important subject.

General phenomena of comets. When examined through a good telescope, a comet resembles a mass of aqueous vapours encircling an opaque nucleus of different degrees of darkness in different comets, though sometimes, as in the case of several discovered by Dr Herschel, no nucleus can be seen. As the comet advances towards the sun, its faint and nebulous light becomes more brilliant, and its luminous train gradually increases in length. When it reaches its perihelion, the intensity of its light, and the length of its tail, reach their maximum, and sometimes it shines with all the splendour of Venus. During its retreat from the perihelion, it is shorn of its splendour, it gradually resumes its nebulous appearance, and its tail decreases in magnitude till it reaches such a distance from the earth, that the attenuated light of the sun, which it reflects, ceases to make an impression on the organ of sight. Traversing unseen the remote portion of its orbit, the comet wheels its ethereal course far beyond the limits of our system. What region it there visits, or upon what destination it is sent, the limited powers of man are unable to discover. After the lapse of years, we perceive it again returning to our system, and tracing a portion of the same orbit round the sun, which it had formerly described.

Opinions respecting comets. It would be a waste of time to detail the various wild and extravagant opinions which have been entertained respecting these interesting stars. During the ages of barbarism and superstition, they were regarded as the harbingers of awful convulsions, both in the political and in the physical world. Wars, pestilence, and famine, the dethronement of kings, the fall of nations, and the more alarming convulsions of the globe, were the dreadful evils which they presented to the diseased and terrified imaginations of men. As the light of knowledge dissipated these gloomy apprehensions, the absurdities of licentious speculation supplied their place, and all the ingenuity of conjecture was exhausted in assigning some rational office to these wandering planets. Even at the beginning of the 18th century, the friend and companion of Newton regarded them as the abode of the damned. Anxious to know more than what is revealed, the fancy of speculative theologians strove to discover the frightful regions in which vice was to suffer its merited punishment; and the interior caverns of the earth had, in general, been regarded as the awful prison-house in which the Almighty was to dispense the severities of justice. Mr Whiston, however, outstripped all his predecessors in fertility of invention. He pretended not only to fix the residence of the damned, but also the nature of their punishment. Wheeled from the remotest limits of the system, the chilling regions of darkness and cold, the comet wafted them into the very vicinity of the sun; and thus alternately hurried its wretched tenants to the terrifying extremes of chilling cold and devouring fire.

By other astronomers, comets were destined for more scientific purposes. They were supposed to convey back to the planets the electric fluid which is constantly dissipating, or to supply the sun with the fuel which it perpetually consumes. They have been regarded also as the cause of the deluge; and we must confess, that if a natural cause is to be sought for that great event, we can explain it only by the shock of some celestial body. The transient effect of a comet passing near the earth, could scarcely amount to any great convulsion; but if the earth were actually to receive a direct impulse from one of these bodies, the consequences would be awful. A new direction would be given to its rotatory motion, and the globe would revolve round a new axis. The seas, forsaking their ancient beds, would be hurried by their centrifugal force, to the new equatorial regions; islands and continents, the abodes of men and animals, would be covered by the universal rush of the waters to the new equator, and every vestige of human industry and genius at once destroyed. The chances against such an event, however, are so very numerous, that there is no dread of its occurrence.

Opinions respecting the tails of comets.

Various opinions have been entertained by astronomers respecting the tails of comets. They were supposed by Appian, Cardan, and Tycho Brahe, to be the light of the sun transmitted through the nucleus of the comet, which they believed to be transparent like a lens. Kepler thought, that the impulsion of the solar rays drove away the denser parts of the comet's atmosphere, and thus formed the tail. Descartes ascribes the tail to the refraction of light by the nucleus. Newton maintained, that it is a thin vapour raised by the heat of the sun from the comet. Euler asserts, that the tail is occasioned by the impulsion of the solar rays driving off the atmosphere of the comet; and that the curvature observed in the tail is the joint effect of this impulsive force, and the gravitation of the atmospherical particles to the solid nucleus. Mairan imagines that comets tails are portions of the sun's atmosphere. Dr Hamilton of Dublin supposes them to be streams of electric matter; and Biot supposes with Newton, that the tails are vapours produced by the excessive heat of the sun; and also, that the comets are solid bodies before they reach their perihelion; but that they are afterwards either partly or totally converted into vapour by the intensity of the solar heat.

Defence of Euler's theory.

Of all these theories, that of Euler seems to be most philosophical. Since the comets are composed chiefly of nebulous matter, and have very large atmospheres, the external atmospheric strata must be drawn towards the comet by very slight powers of attraction, and will therefore yield to the smallest impulse. From the great density of the planets, on the contrary, and the small size of their atmospheres, the external strata are attracted towards them with a very great force, and therefore cannot yield, like those of the comets, to a slight impulse. Hence we see the reason why the comets have tails, while none of the planetary bodies exhibit such a phenomenon. Whatever opinion may be entertained of this explanation, it must, at least, be admitted, that if light is a material substance, the atmospherical particles of a comet may have their gravity diminished to such a degree, either by their distance from its centre, or by the rarity of the nucleus, as to yield to the impulse of the solar rays, and be forced behind the nucleus, in the same manner as smoke yields to the impulse of the gentlest breeze.

If this theory is well founded, may we not form an opinion of the density of comets, by comparing their magnitude with the length of their tails; and may we not suppose, that those comets which have no tails are more dense than others, and exercise over the particles of their atmosphere an attractive force, which enables them to resist the impulse of the solar rays.

Dr Brewster's theory of the loss of the comet of 1770.

In the article ASTRONOMY, p. 675, we have already noticed the peculiarities in the motion of the comet of 1770, which we attributed, along with other astronomers, to the disturbances which it had experienced from the action of the planets. As we are convinced, however, that this explanation is too vague and general to be satisfactory, we shall now lay before our readers the theory of the singular phenomena of the comet of 1770, as recently proposed by Dr Brewster. This theory, while it seems to give a rational explanation of these phenomena, affords, at the same time, a plausible solution of some other difficulties in astronomy.

A comet appeared in the year 1770, and was carefully observed for nearly four months by M. Messier. When Prosperin and Pingrè applied themselves to calculate the elements of its orbit, they found that a parabolic path would not represent the observations of Messier, and hence they suspected that its orbit might be sensibly elliptical. M. Lexell of St Petersburgh computed its elements in an elliptical orbit, and he found that its period was five years and a half, and that its greatest distance from the sun did not much exceed that of Jupiter. This curious subject was investigated rather unsuccessfully by Slop, Sejour, and Lambert; and a few years ago it attracted the particular notice of the National Institute of France. At the request of that learned body, Dr Burckhardt repeated all the calculations with the utmost care, and the result of his investigations was a complete confirmation of Lexell's conclusions.

Here then is a most singular anomaly in the motion of this comet. While all the other comets which have been observed, move in orbits stretching far beyond the limits of the solar system, and revolve in periods of long duration, the comet of 1770 never wanders beyond the orbit of Saturn, and completes its revolution in the short period of five years and a half. The return of this body, therefore, was confidently expected by astronomers; but though it must now have completed nearly eight revolutions round the sun, and though more observations have been made in the heavens during the last 40 years than perhaps during the two preceding centuries, yet the comet of 1770 has never re-appeared. We are consequently entitled to conclude, that the comet of 1770 is lost, which could happen only from its uniting with one of the planets, whose orbits it crossed. Now, if such an union took place, two consequences would obviously flow from it. The planet would suffer a sensible derangement in its motions, and its atmosphere would receive a vast accession of that nebulous matter, of which the comets are often wholly composed. Here, then, we have two distinct criteria to enable us to ascertain the individual planet by which the comet was attracted. The path of the comet intersects the orbits only of Venus, the Earth, Mars, the four new planets, and Jupiter, and therefore it must have united with one of these bodies, or with their satellites. Now, since the year 1770, neither Venus, the Earth, Mars, nor Jupiter, have suffered the smallest derangement of this kind, nor have they received any visible addition to their atmospheres. We must, therefore, look to the four new planets for some indication of the presence of a comet, and if they exhibit any phenomena that are unequivocally of this description, we must consider such a coincidence as a strong proof of the theory, or as one of the most wonderful facts in the history of science.

Two of the new planets, Ceres and Pallas, exhibit, in the form and position of their orbits, evident marks of some great derangement; but as this may have arisen from that explosive force, by which they seem to have been separated from a larger planet, (see ASTRONOMY, p. 641,) we are not entitled to regard it as a proof of the present theory. But though we cannot employ our first criterion either for or against the theory, the second applies with irresistible force, and we would entreat the particular attention of our readers to this single point. The two planets Ceres and Pallas, are actually surrounded with atmospheres of an immense size. The atmosphere of Ceres is 675 English miles high, while that of Pallas rises to the height of 468 miles. Now the height of any of these atmospheres is greater than the united heights of the atmospheres of all the other planets, and is above a thousand times higher than it ought to have been, according to the ratio which exists between the globes and the atmospheres of all the other bodies of the system. Astronomers were so forcibly struck with the magnitude of these atmospheres, that a dispute arose whether Ceres and Pallas should be called planets or comets, and the discussion terminated, by giving them the name of asteroids, a class of bodies which were supposed to partake of the nature both of planets and comets. But to draw this argument still closer upon the subject, let us enquire from what other source these atmospheres could be derived, if they were not imparted by the comet of 1770. If the four new planets are the fragments of a larger body, endowed with an extensive atmosphere, each fragment would obviously carry off a portion of atmosphere proportioned to its magnitude; but two of the fragments, Juno and Vesta, have no atmosphere at all, consequently the atmospheres of Ceres and Pallas could not have been derived from the original planet, but must have been communicated to them at a period posterior to the divergency of the fragments.

It would have been a satisfactory addition to the preceding arguments, if we had been able to shew, by direct calculation, that Ceres and Pallas were at the same instant with the comet in that part of their orbits which was crossed by its path, and that the position of the planes of the orbits was such, as to permit a near approximation. But as we have no data sufficiently correct for such a calculation, we must leave this part of the subject to some future opportunity. There is one fact, however, which in some measure supplies its place, and which is therefore worthy of particular notice. The nodes of the comet of 1770, lie exactly between the nodes of Ceres and Pallas, an arrangement which is absolutely indispensible to the truth of the preceding theory.

We shall now conclude this article with three Tables, containing 1st, The parabolic motion of comets in an orbit, whose perihelion distance is equal to the mean distance of the earth from the sun; 2d, The parabolic descent of comets towards the sun in a right line; and, 3d, The elliptic motion of comets. Although these Tables occupy more room than we could have wished to allot to this subject, yet as they were never before published in any English work, and as they are extremely useful and important to astronomers, we have presented them in as abridged a form as possible.

TABLE I. *Of the Parabolic Motion of a Comet, whose Perihelion Distance is equal to the Radius of the Earth's Orbit.*

Days, and decimals of a day.	True Anomaly. ° ′ ″	Difference. ′ ″	Days, and decimals of a day.	True Anomaly. ° ′ ″	Difference. ′ ″	Days, and decimals of a day.	True Anomaly. ° ′ ″	Difference. ′ ″	Days, and decimals of a day.	True Anomaly. ° ′ ″	Difference. ′ ″	Days, and decimals of a day.	True Anomaly. ° ′ ″	Difference. ′ ″
0.00	0 0 0													
0.25	0 20 54	20 54	5.25	7 17 53	20 45	10.25	14 8 32	20 18	15.25	20 47 22	19 35	20.25	27 9 59	18 42
0.50	0 41 48	20 54	5.50	7 38 37	20 44	10.50	14 28 48	20 16	15.50	21 6 55	19 33	20.50	27 28 37	18 38
0.75	1 2 43	20 55	5.75	7 59 20	20 43	10.75	14 49 2	20 14	15.75	21 26 25	19 30	20.75	27 47 13	18 36
1.00	1 23 37	20 54	6.00	8 20 2	20 42	11.00	15 9 14	20 12	16.00	21 45 53	19 28	21.00	28 5 45	18 32
1.25	1 44 31	20 54	6.25	8 40 43	20 41	11.25	15 29 24	20 10	16.25	22 5 18	19 25	21.25	28 24 15	18 30
1.50	2 5 25	20 54	6.50	9 1 23	20 40	11.50	15 49 33	20 9	16 50	22 24 41	19 23	21.50	28 42 41	18 26
1.75	2 26 18	20 53	6.75	9 22 1	20 38	11.75	16 9 39	20 6	16.75	22 44 1	19 20	21.75	29 1 5	18 24
2.00	2 47 12	20 54	7.00	9 42 38	20 37	12.00	16 29 43	20 4	17.00	23 3 19	19 18	22.00	29 19 25	18 20
2.25	3 8 5	20 53	7.25	10 3 14	20 36	12.25	16 49 45	20 2	17.25	23 22 34	19 15	22.25	29 37 42	18 17
2.50	3 28 57	20 52	7.50	10 23 49	20 35	12.50	17 9 45	20 0	17.50	23 41 46	19 12	22.50	29 55 57	18 15
2.75	3 49 49	20 52	7.75	10 44 22	20 33	12.75	17 29 43	19 58	17.75	24 0 56	19 10	22.75	30 14 8	18 11
3.00	4 10 40	20 51	8.00	11 4 54	20 32	13.00	17 49 39	19 56	18.00	24 20 3	19 7	23.00	30 32 16	18 8
3.25	4 31 31	20 51	8.25	11 25 24	20 30	13.25	18 9 32	19 53	18.25	24 39 7		23.25	30 50 21	18 5
3.50	4 52 21	20 50	8.50	11 45 53	20 29	13.50	18 29 24	19 52	18.50	24 58 8	19 1	23.50	31 8 23	18 2
3.75	5 13 11	20 50	8.75	12 6 20	20 27	13.75	18 49 14	19 50	18.75	25 17 7	18 59	23.75	31 26 21	17 58
4.00	5 34 0	20 49	9.00	12 26 46	20 26	14.00	19 9 1	19 47	19.00	25 36 3	18 56	24.00	31 44 17	17 56
4.25	5 54 48	20 48	9.25	12 47 10		14.25	19 28 46	19 45	19.25	25 54 56	18 53	24.25	32 2 9	17 52
4.50	6 15 35	20 47	9.50	13 7 33	20 23	14.50	19 48 29	19 42	19.50	26 13 46	18 50	24.50	32 19 58	17 49
4.75	6 36 22	20 47	9.75	13 27 54	20 21	14.75	20 8 9	19 40	19.75	26 32 33	18 47	24.75	32 37 44	17 46
5.00	6 57 8	20 46	10.00	13 48 14	20 20	15.00	20 27 47	19 38	20.00	26 51 17	18 44	25.00	32 55 27	17 43

TABLE I. *Of the Parabolic Motion of a Comet, &c.—Continued.*

Days, and decimals of a day.	True Anomaly. °	′	″	Difference. ′	″
25.25	33	13	6	17	39
25.50	33	30	42	17	36
25.75	33	48	15	17	33
26.00	34	5	45	17	30
26.25	34	23	11	17	26
26.50	34	40	34	17	23
26.75	34	57	54	17	20
27.00	35	15	11	17	17
27.25	35	32	25		
27.50	35	49	35	17	10
27.75	36	6	42	17	7
28.00	36	23	45	17	3
28.25	36	40	45	17	0
28.50	36	57	42	16	57
28.75	37	14	35	16	53
29.00	37	31	25	16	50
29.25	37	48	11	16	46
29.50	38	4	54	16	43
29.75	38	21	34	16	40
30.00	38	38	11	16	37
30.25	38	54	44	16	33
30.50	39	11	14	16	30
30.75	39	27	41	16	27
31.00	39	44	4	16	23
31.25	40	0	24	16	20
31.50	40	16	40	16	16
31.75	40	32	53	16	13
32.00	40	49	3	16	10
32.25	41	5	10	16	7
32.50	41	21	13	16	3
32.75	41	37	13	16	0
33.00	41	53	9	15	56
33.25	42	9	2	15	53
33.50	42	24	51	15	49
33.75	42	40	37	15	46
34.00	42	56	19	15	42
34.25	43	11	58	15	39
34.50	43	27	34	15	36
34.75	43	43	6	15	32
35.00	43	58	35	15	29
35.25	44	14	1	15	26
35.50	44	29	23	15	22
35.75	44	44	42	15	19
36.00	44	59	58	15	16
36.25	45	15	10		
36.50	45	30	19	15	9
36.75	45	45	25	15	6
37.00	46	0	27	15	2
37.25	46	15	26	14	59
37.50	46	30	21	14	55

Days, and decimals of a day.	True Anomaly. °	′	″	Difference. ′	″
37.75	46	45	13	14	52
38.00	47	0	2	14	49
38.25	47	14	47	14	45
38.50	47	29	29	14	42
38.75	47	44	8	14	39
39.00	47	58	44	14	36
39.25	48	13	16	14	32
39.50	48	27	45	14	29
39.75	48	42	11	14	26
40.00	48	56	34	14	23
40.25	49	10	54	14	20
40.50	49	25	10	14	16
40.75	49	39	23	14	13
41.00	49	53	32	14	9
41.25	50	7	38	14	6
41.50	50	21	41	14	3
41.75	50	35	41	14	0
42.00	50	49	38	13	57
42.25	51	3	31	13	53
42.50	51	17	21	13	50
42.75	51	31	8	13	47
43.00	51	44	52	13	44
43.25	51	58	33	13	41
43.50	52	12	10	13	37
43.75	52	25	44	13	34
44.00	52	39	15	13	31
44.25	52	52	43	13	28
44.50	53	6	8	13	25
44.75	53	19	29	13	21
45.00	53	32	48	13	19
45.25	53	46	3		
45.50	53	59	16	13	13
45.75	54	12	25	13	9
46.00	54	25	31	13	6
46.25	54	38	34	13	3
46.50	54	51	35	13	1
46.75	55	4	32	12	57
47.00	55	17	26	12	54
47.25	55	30	17	12	51
47.50	55	43	5	12	48
47.75	55	55	49	12	44
48.00	56	8	31	12	42
48.25	56	21	10	12	39
48.50	56	33	45	12	35
48.75	56	46	18	12	33
49.00	56	58	48	12	30
49.25	57	11	15	12	27
49.50	57	23	39	12	2[illegible]
49.75	57	36	0	12	21
50.00	57	48	18	12	18

Days, and decimals of a day.	True Anomaly. °	′	″	Difference. ′	″
50.25	58	0	33	12	15
50.50	58	12	45	12	12
50.75	58	24	55	12	10
51.00	58	37	2	12	7
51.25	58	49	6	12	4
51.50	59	1	7	12	1
51.75	59	13	5	11	58
52.00	59	25	1	11	56
52.25	59	36	54	11	53
52.50	59	48	44	11	50
52.75	60	0	31	11	47
53.00	60	12	15	11	44
53.25	60	23	56	11	41
53.50	60	35	35	11	39
53.75	60	47	11	11	36
54.00	60	58	44	11	33
54.25	61	10	15		
54.50	61	21	43	11	28
54.75	61	33	8	11	25
55.00	61	44	30	11	22
55.25	61	55	50	11	20
55.50	62	7	7	11	17
55.75	62	18	21	11	14
56.00	62	29	32	11	11
56.25	62	40	41	11	9
56.50	62	51	47	11	6
56.75	63	2	51	11	4
57.00	63	13	52	11	1
57.25	63	24	50	10	58
57.50	63	35	46	10	56
57.75	63	46	39	10	53
58.00	63	57	30	10	51
58.25	64	8	18	10	48
58.50	64	19	4	10	46
58.75	64	29	47	10	43
59.00	64	40	28	10	41
59.25	64	51	6	10	38
59.50	65	1	42	10	36
59.75	65	12	15	10	33
60.00	65	22	45	10	30
60.25	65	33	13	10	28
60.50	65	43	39	10	26
60.75	65	54	2	10	23
61.00	66	4	23	10	21
61.25	66	14	41	10	18
61.50	66	24	57	10	16
61.75	66	35	11	10	14
62.00	66	45	22	10	11
62.25	66	55	31	10	9
62.50	67	5	37	10	6

Days, and decimals of a day.	True Anomaly. °	′	″	Difference. ′	″
62.75	67	15	41	10	4
63.00	67	25	43	10	2
63.25	67	35	43		
63.50	67	45	40	9	57
63.75	67	55	35	9	55
64.00	68	5	27	9	52
64.25	68	15	17	9	50
64.50	68	25	5	9	48
64.75	68	34	51	9	46
65.00	68	44	34	9	43
65.25	68	54	15	9	41
65.50	69	3	54	9	39
65.75	69	13	31	9	37
66.00	69	23	5	9	34
66.25	69	32	37	9	32
66.50	69	42	7	9	30
66.75	69	51	35	9	28
67.00	70	1	1	9	26
67.25	70	10	25	9	24
67.50	70	19	46	9	21
67.75	70	29	5	9	19
68.00	70	38	22	9	17
68.25	70	47	37	9	15
68.50	70	56	50	9	13
68.75	71	6	0	9	10
69.00	71	15	9	9	9
69.25	71	24	16	9	7
69.50	71	33	20	9	4
69.75	71	42	23	9	3
70.00	71	51	23	9	0
70.25	72	0	21	8	58
70.50	72	9	18	8	57
70.75	72	18	12	8	54
71.00	72	27	4	8	52
71.25	72	35	54	8	50
71.50	72	44	42	8	48
71.75	72	53	29	8	47
72.00	73	2	13	8	44
72.25	73	10	55		
72.50	73	19	36	8	41
72.75	73	28	14	8	38
73.00	73	36	51	8	37
73.25	73	45	25	8	34
73.50	73	53	58	8	33
73.75	74	2	29	8	31
74.00	74	10	58	8	29
74.25	74	19	25	8	27
74.50	74	27	50	8	25
74.75	74	36	13	8	23
75.00	74	44	34	8	21

Days, and decimals of a day.	True Anomaly. °	′	″	Difference. ′	″
75.25	74	52	53	8	19
75.50	75	1	11	8	18
75.75	75	9	26	8	15
76.00	75	17	40	8	14
76.25	75	25	52	8	12
76.50	75	34	2	8	10
76.75	75	42	11	8	9
77.00	75	50	18	8	7
77.25	75	58	23	8	5
77.50	76	6	26	8	3
77.75	76	14	28	8	2
78.00	76	22	28	8	0
78.25	76	30	26	7	58
78.50	76	38	22	7	56
78.75	76	46	16	7	54
79.00	76	54	9	7	53
79.25	77	2	0	7	51
79.50	77	9	49	7	49
79.75	77	17	37	7	48
80.00	77	25	23	7	46
80.25	77	33	7	7	44
80.50	77	40	50	7	43
80.75	77	48	31	7	41
81.00	77	56	10	7	39
81.25	78	3	47		
81.50	78	11	23	7	36
81.75	78	18	57	7	34
82.00	78	26	30	7	33
82.25	78	34	1	7	31
82.50	78	41	31	7	30
82.75	78	48	59	7	28
83.00	78	56	25	7	26
83.25	79	3	50	7	25
83.50	79	11	13	7	23
83.75	79	18	35	7	22
84.00	79	25	55	7	20
84.25	79	33	13	7	18
84.50	79	40	30	7	17
84.75	79	47	45	7	15
85.00	79	54	59	7	14
85.25	80	2	11	7	12
85.50	80	9	22	7	11
85.75	80	16	31	7	9
86.00	80	23	38	7	7
86.25	80	30	44	7	6
86.50	80	37	49	7	5
36.75	80	44	53	7	4
87.00	80	51	55	7	2
87.25	80	58	55	7	0
87.50	81	5	54	6	59

Table I. *Of the Parabolic Motion of a Comet, &c.—Continued.*

Days, and decimals of a day.	True Anomaly.	Difference.	Days, and decimals of a day.	True Anomaly.	Difference.	Days, and decimals of a day.	True Anomaly.	Difference.	Days.	True Anomaly.	Difference.	Days.	True Anomaly.	Difference.
	° ′ ″	′ ″		° ′ ″	′ ″		° ′ ″	′ ″		° ′ ″	′ ″		° ′ ″	′ ″
87.75	81 12 52	6 58	100.50	86 38 14	11 46	125.50	95 2 52	8 43	151	101 31 47	13 27	201	110 33 37	8 50
88.00	81 19 48	6 56	101.00	86 49 55	11 41	126.00	95 11 32	8 40	152	101 45 6	13 19	202	110 42 23	8 46
88.25	81 26 43	6 55	101.50	87 1 31	11 36	126.50	95 20 9	8 37	153	101 58 18	13 12	203	110 51 5	8 42
88.50	81 33 36	6 53	102.00	87 13 3	11 32	127.00	95 28 44	8 35	154	102 11 22	13 4	204	110 59 43	8 38
88.75	81 40 28	6 52	102.50	87 24 30	11 27	127.50	95 37 16	8 32	155	102 24 19		205	111 8 18	8 35
89.00	81 47 18	6 50	103.00	87 35 53	11 23	128.00	95 45 45	8 29	156	102 37 9	12 50	206	111 16 49	8 31
89.25	81 54 7	6 49	103.50	87 47 12	11 19	128.50	95 54 11	8 26	157	102 49 52	12 43	207	111 25 17	8 28
89.50	82 0 54	6 47	104.00	87 58 26	11 14	129.00	96 2 35	8 24	158	103 2 27	12 35	208	111 33 40	8 23
89.75	82 7 40	6 46	104.50	88 9 36	11 10	129.50	96 10 56	8 21	159	103 14 56	12 29	209	111 42 0	8 20
90.00	82 14 25	6 45	105.00	88 20 43	11 7	130.00	96 19 14	8 18	160	103 27 18	12 22	210	111 50 17	8 17
90.25	82 21 8		105.50	88 31 45	11 2	130.50	96 27 29	8 15	161	103 39 34	12 16	211	111 58 30	8 13
90.50	82 27 50	6 42	106.00	88 42 43	10 58	131.00	96 35 42	8 13	162	103 51 42	12 8	212	112 6 40	8 10
90.75	82 34 31	6 41	106.50	88 53 37	10 54	131.50	96 43 52	8 10	163	104 3 44	12 2	213	112 14 45	8 5
91.00	82 41 10	6 39	107.00	89 4 26	10 49	132.00	96 52 0	8 8	164	104 15 40	11 56	214	112 22 48	8 3
91.25	82 47 48	6 38	107.50	89 15 11	10 45	132.50	97 0 5	8 5	165	104 27 29	11 49	215	112 30 48	8 0
91.50	82 54 24	6 36	108.00	89 25 53	10 42	133.00	97 8 7	8 2	166	104 39 13	11 44	216	112 38 44	7 56
91.75	83 0 59	6 35	108.50	89 36 31	10 38	133.50	97 16 7	8 0	167	104 50 50	11 37	217	112 46 36	7 53
92.00	83 7 33	6 34	109.00	89 47 5	10 34	134.00	97 24 4	7 57	168	105 2 20	11 30	218	112 54 26	7 49
92.25	83 14 6	6 33	109.50	89 57 35	10 30	134.50	97 31 59		169	105 13 45	11 25	219	113 2 12	7 46
92.50	83 20 37	6 31	110.00	90 8 1	10 26	135.00	97 39 51	7 52	170	105 25 4	11 19	220	113 9 56	7 44
92.75	83 27 8	6 31	110.50	90 18 23	10 22	135.50	97 47 41	7 50	171	105 36 17	11 13	221	113 17 36	7 40
93.00	83 33 36	6 28	111.00	90 28 42	10 19	136.00	97 55 28	7 47	172	105 47 25	11 8	222	113 25 13	7 37
93.25	83 40 3	6 27	111.50	90 38 57	10 15	136.50	98 3 13	7 45	173	105 58 27	11 2	223	113 32 46	7 33
93.50	83 46 29	6 26	112.00	90 49 8	10 11	137.00	98 10 56	7 43	174	106 9 23	10 56	224	113 40 17	7 31
93.75	83 52 54	6 25	112.50	90 59 16	10 8	137.50	98 18 36	7 40	175	106 20 14	10 51	225	113 47 45	7 28
94.00	83 59 17	6 23	113.00	91 9 20	10 4	138.00	98 26 14	7 38	176	106 30 59	10 45	226	113 55 10	7 25
94.25	84 5 39	6 22	113.50	91 19 20	10 0	138.50	98 33 50	7 36	177	106 41 39	10 40	227	114 2 32	
94.50	84 12 0	6 21	114.00	91 29 17	9 57	139.00	98 41 23	7 33	178	106 52 14	10 35	228	114 9 51	7 19
94.75	84 18 20	6 20	114.50	91 39 10	9 53	139.50	98 48 54	7 31	179	107 2 43	10 29	229	114 17 7	7 16
95.00	84 24 38	6 18	115.00	91 49 0	9 50	140.00	98 56 22	7 28	180	107 13 7	10 24	230	114 24 21	7 14
95.25	84 30 55	6 17	115.50	91 58 47	9 47	140.50	99 3 49	7 27	181	107 23 26	10 19	231	114 31 32	7 11
95.50	84 37 11	6 16	116.00	92 8 30	9 43	141.00	99 11 13	7 24	182	107 33 40	10 14	232	114 38 39	7 7
95.75	84 43 26	6 15	116.50	92 18 10		141.50	99 18 35	7 22	183	107 43 49	10 9	233	114 45 44	7 5
96.00	84 49 39	6 13	117.00	92 27 46	9 36	142.00	99 25 54	7 19	184	107 53 54	10 5	234	114 52 47	7 3
96.25	84 55 51	6 12	117.50	92 37 19	9 33	142.50	99 33 12	7 18	185	108 3 54	10 0	235	114 59 47	7 0
96.50	85 2 2	6 11	118.00	92 46 48	9 29	143.00	99 40 27	7 15	186	108 13 48	9 54	236	115 6 44	6 57
96.75	85 8 12	6 10	118.50	92 56 14	9 26	143.50	99 47 40	7 13	187	108 23 38	9 50	237	115 13 38	6 54
97.00	85 14 20	6 8	119.00	93 5 37	9 23	144.00	99 54 51	7 11	188	108 33 23	9 45	238	115 20 30	6 52
97.25	85 20 27	6 7	119.50	93 14 57	9 20	144.50	100 2 0	7 9	189	108 43 4	9 41	239	115 27 19	6 49
97.50	85 26 33	6 6	120.00	93 24 13	9 16	145.00	100 9 6	7 6	190	108 52 41	9 37	240	115 34 5	6 46
97.75	85 32 38	6 5	120.50	93 33 26	9 13	145.50	100 16 10	7 4	191	109 2 13		241	115 40 49	6 44
98.00	85 38 42	6 4	121.00	93 42 37	9 11	146.00	100 23 13	7 3	192	109 11 40	9 27	242	115 47 31	6 42
98.25	85 44 45	6 3	121.50	93 51 44	9 7	146.50	100 30 13	7 0	193	109 21 8	9 23	243	115 54 10	6 39
98.50	85 50 46	6 1	122.00	94 0 48	9 4	147.00	100 37 12	6 59	194	109 30 22	9 19	244	116 0 46	6 36
98.75	85 56 46	6 0	122.50	94 9 49	9 1	147.50	100 44 8	6 56	195	109 39 37	9 15	245	116 7 20	6 34
99.00	86 2 45	5 59	123.00	94 18 47	8 58	148.00	100 51 3	6 55	196	109 48 47	9 10	246	116 13 52	6 32
99.25	86 8 43		123.50	94 27 42	8 55	148.50	100 57 55	6 52	197	109 57 53	9 6	247	116 20 22	6 30
99.50	86 14 39	5 56	124.00	94 36 34	8 52	149.00	101 4 45	6 50	198	110 6 55	9 2	248	116 26 49	6 27
99.75	86 20 34	5 55	124.50	94 45 23	8 49	149.50	101 11 33	6 48	199	110 15 53	8 58	249	116 33 14	6 25
100.00	86 26 28	5 54	125.00	94 54 9	8 46	150.00	101 18 20	6 47	200	110 24 47	8 54	250	116 39 36	6 22

Table I. *Of the Parabolic Motion of a Comet, &c.—Continued.*

Days.	True Anomaly.			Difference.	
	°	′	″	′	″
251	116	45	56	6	20
252	116	52	14	6	18
253	116	58	30	6	16
254	117	4	43	6	13
255	117	10	54	6	11
256	117	17	3	6	9
257	117	23	10	6	7
258	117	29	15	6	5
259	117	35	18	6	3
260	117	41	18	6	0
261	117	47	17	5	59
262	117	53	13	5	56
263	117	59	7		
264	118	5	0	5	53
265	118	10	50	5	50
266	118	16	39	5	49
267	118	22	25	5	46
268	118	28	10	5	45
269	118	33	52	5	42
270	118	39	33	5	41
271	118	45	12	5	39
272	118	50	49	5	37
273	118	56	24	5	35
274	119	1	57	5	33
275	119	7	28	5	31
276	119	12	58	5	30
277	119	18	26	5	28
278	119	23	52	5	26
279	119	29	16	5	24
280	119	34	39	5	23
281	119	40	0	5	21
282	119	45	19	5	19
283	119	50	36	5	17
284	119	55	52	5	16
285	120	1	6	5	14
286	120	6	18	5	12
287	120	11	29	5	11
288	120	16	38	5	9
289	120	21	46	5	8
290	120	26	52	5	6
291	120	31	56	5	4
292	120	36	59	5	3
293	120	42	1	5	2
294	120	47	0	4	59
295	120	51	59	4	59
296	120	56	55	4	56
297	121	1	51	4	56
298	121	6	44	4	53
299	121	11	36		
300	121	16	27	4	51

Days.	True Anomaly.			Difference.	
	°	′	″	′	″
301	121	21	17	4	50
302	121	26	5	4	48
303	121	30	51	4	46
304	121	35	36	4	45
305	121	40	20	4	44
306	121	45	2	4	42
307	121	49	43	4	41
308	121	54	23	4	40
309	121	59	1	4	38
310	122	3	38	4	37
311	122	8	13	4	35
312	122	12	47	4	34
313	122	17	20	4	33
314	122	21	52	4	32
315	122	26	22	4	30
316	122	30	51	4	29
317	122	35	18	4	27
318	122	39	45	4	27
319	122	44	10	4	25
320	122	48	34	4	24
321	122	52	57	4	23
322	122	57	18	4	21
323	123	1	38	4	20
324	123	5	57	4	19
325	123	10	15	4	18
326	123	14	32	4	17
327	123	18	48	4	16
328	123	23	2	4	14
329	123	27	15	4	13
330	123	31	27	4	12
331	123	35	38	4	11
332	123	39	48	4	10
333	123	43	56	4	8
334	123	48	4	4	8
335	123	52	10		
336	123	50	16	4	6
337	124	0	20	4	4
338	124	4	23	4	3
339	124	8	25	4	2
340	124	12	26	4	1
341	124	16	26	4	0
342	124	20	25	3	59
343	124	24	23	3	58
344	124	28	19	3	56
345	124	32	15	3	56
346	124	36	10	3	55
347	124	40	4	3	54
348	124	43	57	3	53
349	124	47	48	3	51
350	124	51	39	3	51

Days.	True Anomaly.			Difference.	
	°	′	″	′	″
351	124	55	29	3	50
352	124	59	17	3	48
353	125	3	5	3	48
354	125	6	52	3	47
355	125	10	38	3	46
356	125	14	23	3	45
357	125	18	7	3	44
358	125	21	50	3	43
359	125	25	32	3	42
360	125	29	13	3	41
361	125	32	54	3	41
362	125	36	33	3	39
363	125	40	11	3	38
364	125	43	49	3	38
365	125	47	26	3	37
366	125	51	1	3	35
367	125	54	36	3	35
368	125	58	10	3	34
369	126	1	44	3	34
370	126	5	16	3	32
371	126	8	47		
372	126	12	18	3	31
373	126	15	48	3	30
374	126	19	17	3	29
375	126	22	45	3	28
376	126	26	12	3	27
377	126	29	38	3	26
378	126	33	4	3	26
379	126	36	29	3	25
380	126	39	53	3	24
381	126	43	16	3	23
382	126	46	39	3	23
383	126	50	0	3	21
384	126	53	21	3	21
385	126	56	41	3	20
386	127	0	0	3	19
387	127	3	19	3	19
388	127	6	37	3	18
389	127	9	54	3	17
390	127	13	10	3	16
391	127	16	25	3	15
392	127	19	40	3	15
393	127	22	54	3	14
394	127	26	7	3	13
395	127	29	20	3	13
396	127	32	32	3	12
397	127	35	43	3	11
398	127	38	53	3	10
399	127	42	3	3	10
400	127	45	12	3	9

Days.	True Anomaly.			Difference.	
	°	′	″	′	″
401	127	48	20	3	8
402	127	51	27	3	7
403	127	54	34	3	7
404	127	57	40	3	6
405	128	0	46	3	6
406	128	3	51	3	5
407	128	6	55		
408	128	9	58	3	3
409	128	13	1	3	3
410	128	16	3	3	2
411	128	19	5	3	2
412	128	22	6	3	1
413	128	25	6	3	0
414	128	28	5	2	59
415	128	31	4	2	59
416	128	34	2	2	58
417	128	37	0	2	58
418	128	39	57	2	57
419	128	42	53	2	56
420	128	45	49	2	56
421	128	48	44	2	55
422	128	51	38	2	54
423	128	54	32	2	54
424	128	57	25	2	53
425	129	0	18	2	53
426	129	3	10	2	52
427	129	6	1	2	51
428	129	8	52	2	51
429	129	11	42	2	50
430	129	14	32	2	50
431	129	17	21	2	49
432	129	20	9	2	48
433	129	22	57	2	48
434	129	25	45	2	48
435	129	28	31	2	46
436	129	31	17	2	46
437	129	34	3	2	46
438	129	36	48	2	45
439	129	39	32	2	44
440	129	42	16	2	44
441	129	45	0	2	44
442	129	47	43	2	43
443	129	50	25		
444	129	53	7	2	42
445	129	55	48	2	41
446	129	58	29	2	41
447	130	1	9	2	40
448	130	3	48	2	39
449	130	6	27	2	39
450	130	9	6	2	39

Days.	True Anomaly.			Difference.	
	°	′	″	′	″
451	130	11	44	2	38
452	130	14	21	2	37
453	130	16	58	2	37
454	130	19	35	2	37
455	130	22	11	2	36
456	130	24	46	2	35
457	130	27	21	2	35
458	130	29	55	2	34
459	130	32	29	2	34
460	130	35	3	2	34
461	130	37	36	2	33
462	130	40	8	2	32
463	130	42	40	2	32
464	130	45	11	2	31
465	130	47	42	2	31
466	130	50	13	2	31
467	130	52	43	2	30
468	130	55	13	2	30
469	130	57	41	2	28
470	131	0	10	2	29
471	131	2	38	2	28
472	131	5	6	2	28
473	131	7	33	2	27
474	131	10	0	2	27
475	131	12	26	2	26
476	131	14	52	2	26
477	131	17	18	2	26
478	131	19	43	2	25
479	131	22	7		
480	131	24	31	2	24
481	131	26	55	2	24
482	131	29	18	2	23
483	131	31	40	2	22
484	131	34	3	2	23
485	131	36	25	2	22
486	131	38	46	2	21
487	131	41	7	2	21
488	131	43	27	2	20
489	131	45	47	2	20
490	131	48	7	2	20
491	131	50	26	2	19
492	131	52	45	2	19
493	131	55	4	2	19
494	131	57	22	2	18
495	131	59	39	2	17
496	132	1	56	2	17
497	132	4	13	2	17
498	132	6	30	2	17
499	132	8	46	2	16
500	132	11	1	2	15

TABLE I. *Of the Parabolic Motion of a Comet, &c.—Continued.*

Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″
501	132 13 16	2 15	551	133 58 5		605	135 36 34	8 34	910	141 59 58	9 28	1410	147 40 48	5 3
502	132 15 31	2 15	552	134 0 2	1 57	610	135 45 2	8 28	920	142 9 17	9 19	1420	147 45 47	4 59
503	132 17 46	2 15	553	134 1 59	1 57	615	135 53 24	8 22	930	142 18 28	9 11	1430	147 50 44	4 57
504	132 20 0	2 14	554	134 3 55	1 56	620	136 1 40	8 16	940	142 27 30	9 2	1440	147 55 38	4 54
505	132 22 13	2 13	555	134 5 51	1 56	625	136 9 50	8 10	950	142 36 24	8 54	1450	148 0 28	4 50
506	132 24 26	2 13	556	134 7 47	1 56	630	136 17 54	8 4	960	142 45 10	8 46	1460	148 5 16	4 48
507	132 26 39	2 13	557	134 9 42	1 55	635	136 25 53	7 59	970	142 53 48	8 38	1470	148 10 2	4 46
508	132 28 51	2 12	558	134 11 33	1 56	640	136 33 46	7 53	980	143 2 19	8 31	1480	148 14 44	4 42
509	132 31 3	2 12	559	134 13 33	1 55	645	136 41 34	7 48	990	143 10 42		1490	148 19 24	4 40
510	132 33 15	2 12	560	134 15 27	1 54	650	136 49 16	7 42	1000	143 18 57	8 15	1500	148 24 1	4 37
511	132 35 26	2 11	561	134 17 22	1 55	655	136 56 53	7 37	1010	143 27 6	8 9	1510	148 28 35	4 34
512	132 37 37	2 11	562	134 19 16	1 54	660	137 4 25	7 32	1020	143 35 7	8 1	1520	148 33 7	4 32
513	132 39 48	2 11	563	134 21 9	1 53	665	137 11 53	7 28	1030	143 43 2	7 55	1530	148 37 37	4 30
514	132 41 58	2 10	564	134 23 3	1 54	670	137 19 16	7 23	1040	143 50 51	7 49	1540	148 42 4	4 27
515	132 44 8		565	134 24 56	1 53	675	137 26 33	7 17	1050	143 58 33	7 42	1550	148 46 28	4 24
516	132 46 17	2 9	566	134 26 49	1 53	680	137 33 45	7 12	1060	144 6 8	7 35	1560	148 50 50	4 22
517	132 48 26	2 9	567	134 28 42	1 53	685	137 40 53	7 8	1070	144 13 38	7 30	1570	148 55 10	4 20
518	132 50 35	2 9	568	134 30 34	1 52	690	137 47 57	7 4	1080	144 21 1	7 23	1580	148 59 27	4 17
519	132 52 43	2 8	569	134 32 26	1 52	695	137 54 56	6 59	1090	144 28 19	7 18	1590	149 3 42	4 15
520	132 54 51	2 8	570	134 34 17	1 51	700	138 1 51	6 55	1100	144 35 31	7 12	1600	149 7 55	4 13
521	132 56 59	2 8	571	134 36 9	1 52	705	138 8 42	6 51	1110	144 42 37	7 6	1610	149 12 6	4 11
522	132 59 6	2 7	572	134 38 0	1 51	710	138 15 28	6 46	1120	144 49 38	7 1	1620	149 16 14	4 8
523	133 1 13	2 7	573	134 39 51	1 51	715	138 22 10		1130	144 56 34	6 56	1630	149 20 20	4 6
524	133 3 19	2 6	574	134 41 41	1 50	720	138 28 48	6 38	1140	145 3 24	6 50	1640	149 24 24	4 4
525	133 5 25	2 6	575	134 43 32	1 51	725	138 35 22	6 34	1150	145 10 9	6 45	1650	149 28 26	4 2
526	133 7 31	2 6	576	134 45 22	1 50	730	138 41 51	6 29	1160	145 16 49	6 40	1660	149 32 26	4 0
527	133 9 36	2 5	577	134 47 11	1 49	735	138 48 17	6 26	1170	145 23 25	6 36	1670	149 36 24	3 58
528	133 11 41	2 5	578	134 49 1	1 50	740	138 54 40	6 23	1180	145 29 55	6 30	1680	149 40 20	3 56
529	133 13 46	2 5	579	134 50 50	1 49	745	139 0 59	6 19	1190	145 36 21	6 26	1690	149 44 14	3 54
530	133 15 50	2 4	580	134 52 39	1 49	750	139 7 14	6 15	1200	145 42 42	6 21	1700	149 48 6	3 52
531	133 17 54	2 4	581	134 54 27	1 48	755	139 13 26	6 12	1210	145 48 59	6 17	1710	149 51 56	
532	133 19 58	2 4	582	134 56 16	1 49	760	139 19 34	6 8	1220	145 55 11	6 12	1720	149 55 44	3 48
533	133 22 1	2 3	583	134 58 4	1 48	765	139 25 38	6 4	1230	146 1 19	6 8	1730	149 59 31	3 47
534	133 24 4	2 3	584	134 59 51	1 47	770	139 31 39	6 1	1240	146 7 22	6 3	1740	150 3 15	3 44
535	133 26 7	2 3	585	135 1 39	1 48	775	139 37 37	5 58	1250	146 13 22	6 0	1750	150 6 50	3 43
536	133 28 9	2 2	586	135 3 26	1 47	780	139 43 31	5 54	1260	146 19 17	5 55	1760	150 10 39	3 41
537	133 30 11	2 2	587	135 5 13		785	139 49 22	5 51	1270	146 25 9	5 52	1770	150 14 18	3 39
538	133 32 13	2 2	588	135 7 0	1 47	790	139 55 9	5 47	1280	146 30 56	5 47	1780	150 17 56	3 38
539	133 34 14	2 1	589	135 8 46	1 46	795	140 0 54	5 45	1290	146 36 40	5 44	1790	150 21 31	3 35
540	133 36 15	2 1	590	135 10 32	1 46	800	140 6 35	5 41	1300	146 42 20	5 40	1800	150 25 5	3 34
541	133 38 16	2 1	591	135 12 18	1 46	810	140 17 48	11 13	1310	146 47 56	5 36	1810	150 28 37	3 32
542	133 40 16	2 0	592	135 14 4	1 46	820	140 28 50	11 2	1320	146 53 28	5 32	1820	150 32 8	3 31
543	133 42 16	2 0	593	135 15 49	1 45	830	140 39 39	10 49	1330	146 58 57	5 29	1830	150 35 37	3 29
544	133 44 16	2 0	594	135 17 35	1 46	840	140 50 18	10 39	1340	147 4 22	5 25	1840	150 39 5	3 28
545	133 46 15	1 59	595	135 19 20	1 45	850	141 0 45	10 27	1350	147 9 45		1850	150 42 30	3 25
546	133 48 14	1 59	596	135 21 4	1 44	860	141 11 2	10 17	1360	147 15 3	5 18	1860	150 45 55	3 25
547	133 50 13	1 59	597	135 22 48	1 44	870	141 21 9	10 7	1370	147 20 18	5 15	1870	150 49 18	3 23
548	133 52 11	1 58	598	135 24 32	1 44	880	141 31 5	9 56	1380	147 25 30	5 12	1880	150 52 39	3 21
549	133 54 9	1 58	599	135 26 16	1 44	890	141 40 52	9 47	1390	147 30 39	5 9	1890	150 55 59	3 20
550	133 56 7	1 58	600	135 28 0	1 44	900	141 50 30	9 38	1400	147 35 45	5 6	1900	150 59 17	3 18

Table I. *Of the Parabolic Motion of a Comet, &c.—Continued.*

Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″
1910	151 2 34	3 17	2820	154 47 43	3 49	5050	159 26 41	4 15	9100	163 13 14	3 49	17250	166 30 26	4 1
1920	151 5 49	3 15	2840	154 51 30	3 47	5100	159 30 53	4 12	9200	163 17 0	3 46	17500	166 34 24	3 58
1930	151 9 3	3 14	2860	154 55 14		5150	159 35 1	4 8	9300	163 20 43	3 43	17750	166 38 15	3 51
1940	151 12 15	3 12	2880	154 58 56	3 42	5200	159 39 6	4 5	9400	163 24 22	3 39	18000	166 42 3	3 48
1950	151 15 26	3 11	2900	155 2 36	3 40	5250	159 43 8	4 2	9500	163 27 58	3 36	18250	166 45 46	3 43
1960	151 18 36	3 10	2920	155 6 14	3 38	5300	159 47 8	4 0	9600	163 31 31	3 33	18500	166 49 26	3 40
1970	151 21 44	3 8	2940	155 9 50	3 36	5350	159 51 5	3 57	9700	163 35 1	3 30	18750	166 53 1	3 35
1980	151 24 51	3 7	2960	155 13 23	3 33	5400	159 54 59	3 54	9800	163 38 28	3 27	19000	166 56 32	3 31
1990	151 27 57	3 6	2980	155 16 54	3 31	5450	159 58 51	3 52	9900	163 41 52	3 24	19250	167 0 0	3 28
2000	151 31 2	3 5	3000	155 20 23	3 29	5500	160 2 39	3 48	10000	163 45 13	3 21	19500	167 3 24	3 24
2020	151 37 8	6 6	3050	155 29 0	8 37	5550	160 6 24	3 45	10100	163 48 32		19750	167 6 45	3 21
2040	151 43 8	6 0	3100	155 37 26	8 26	5600	160 10 6	3 42	10200	163 51 48	3 16	20000	167 10 2	3 17
2060	151 49 3	5 55	3150	155 45 40	8 14	5650	160 13 45	3 39	10300	163 55 2	3 14	20500	167 16 18	6 16
2080	151 54 53	5 50	3200	155 53 43	8 3	5700	160 17 22	3 37	10400	163 58 12	3 10	21000	167 22 25	6 7
2100	152 0 38	5 45	3250	156 1 35	7 52	5750	160 20 56	3 34	10500	164 1 21	3 9	21500	167 28 23	5 58
2120	152 6 19	5 41	3300	156 9 17	7 42	5800	160 24 28	3 32	10600	164 4 27	3 6	22000	167 34 10	5 47
2140	152 11 55		3350	156 16 48	7 31	5850	160 27 57	3 29	10700	164 7 31	3 4	22500	167 39 47	5 37
2160	152 17 27	5 32	3400	156 24 10	7 22	5900	160 31 24	3 27	10800	164 10 32	3 1	23000	167 45 16	5 29
2180	152 22 55	5 28	3450	156 31 23	7 13	5950	160 34 48	3 24	10900	164 13 31	2 59	23200	167 50 34	5 18
2200	152 28 19	5 24	3500	156 38 27	7 4	6000	160 38 10	3 22	11000	164 16 28	2 57	24000	167 55 47	5 13
2220	152 33 39	5 20	3550	156 45 23	6 56	6100	160 44 47	6 37	11100	164 19 22	2 54	24500	168 0 50	5 3
2240	152 38 54	5 15	3600	156 52 10	6 47	6200	160 51 15	6 28	11200	164 22 15	2 53	25000	168 5 44	4 54
2260	152 44 6	5 12	3650	156 58 49	6 39	6360	160 57 34	6 19	11300	164 25 5	2 50	25500	168 10 32	4 48
2280	152 49 14	5 8	3700	157 5 22	6 33	6400	161 3 46	6 12	11400	164 27 54	2 49	26000	168 15 13	4 41
2300	152 54 18	5 4	3750	157 11 48	6 26	6500	161 9 49		11500	164 30 41	2 47	26500	168 19 45	4 32
2320	152 59 18	5 0	3800	157 18 7	6 19	6600	161 15 45	5 56	11600	164 33 26	2 45	27000	168 24 11	4 26
2340	153 4 15	4 57	3850	157 24 20	6 13	6700	161 21 33	5 48	11700	164 36 8	2 42	27500	168 28 32	4 21
2360	153 9 9	4 54	3900	157 30 27	6 7	6800	161 27 15	5 42	11800	164 38 48	2 40	28000	168 32 46	4 14
2380	153 13 59	4 50	3950	157 36 29	6 2	6900	161 32 50	5 35	11900	164 41 27	2 39	28500	168 36 52	4 6
2400	153 18 45	4 46	4000	157 42 24	5 55	7000	161 38 19	5 29	12000	164 44 4	2 37	29000	168 40 54	4 2
2420	153 23 28	4 43	4050	157 48 13	5 49	7100	161 43 40	5 21	12250	164 50 27	6 23	29500	168 44 50	3 56
2440	153 28 8	4 40	4100	157 53 56	5 43	7200	161 48 55	5 15	12500	164 56 42	6 15	30000	168 48 41	3 51
2460	153 32 45	4 37	4150	157 59 33	5 37	7300	161 54 4	5 9	12750	165 2 46	6 4	30500	168 52 24	
2480	153 37 18	4 33	4200	158 5 4	5 31	7400	161 59 8	5 4	13000	165 8 43	5 57	31000	168 56 2	3 38
2500	153 41 48	4 30	4250	158 10 30	5 26	7500	162 4 7	4 59	13250	165 14 27	5 44	31500	168 59 35	3 33
2520	153 46 15	4 27	4300	158 15 51	5 21	7600	162 9 1	4 54	13500	165 20 4	5 37	32000	169 3 5	3 30
2540	153 50 39	4 24	4350	158 21 6	5 15	7700	162 13 49	4 48	13750	165 25 33	5 29	32500	169 6 32	3 27
2560	153 55 1	4 22	4400	158 26 16	5 10	7800	162 18 32	4 43	14000	165 30 55	5 22	33000	169 9 54	3 22
2580	153 59 20	4 19	4450	158 31 21		7900	162 23 11	4 39	14250	165 36 7	5 12	33500	169 13 12	3 18
2600	154 3 36	4 16	4500	158 36 22	5 1	8000	162 27 45	4 34	14500	165 41 13	5 6	34000	169 16 26	3 14
2620	154 7 49	4 13	4550	158 41 18	4 56	8100	162 32 14	4 29	14750	165 46 12	4 59	34500	169 19 35	3 9
2640	154 12 0	4 11	4600	158 46 9	4 51	8200	162 36 39	4 25	15000	165 51 5	4 53	35000	169 22 41	3 6
2660	154 16 8	4 8	4650	158 50 56	4 47	8300	162 40 59	4 20	15250	165 55 49	4 44	35500	169 25 44	3 3
2680	154 20 14	4 6	4700	158 55 38	4 42	8400	162 45 15	4 16	15500	166 0 29	4 40	36000	169 28 44	3 0
2700	154 24 17	4 3	4750	159 0 16	4 38	8500	162 49 26	4 11	15750	166 5 2	4 33	36500	169 31 40	2 56
2720	154 28 17	4 0	4800	159 4 50	4 34	8600	162 53 34	4 8	16000	166 9 30	4 28	37000	169 34 32	2 52
2740	154 32 15	3 58	4850	159 9 19	4 29	8700	162 57 37	4 3	16250	166 13 52		37500	169 37 21	2 49
2760	154 36 10	3 55	4900	159 13 45	4 26	8800	163 1 37	4 0	16500	166 18 9	4 17	38000	169 40 7	2 46
2780	154 40 3	3 53	4950	159 18 7	4 22	8900	163 5 33	3 56	16750	166 22 19	4 10	38500	169 42 51	2 44
2800	154 43 54	3 51	5000	159 22 26	4 19	9000	163 9 25	3 52	17000	166 26 25	4 6	39000	169 45 31	2 40

Table I. *Of the Parabolic Motion of a Comet, &c.—Continued.*

Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″	Days.	True Anomaly. ° ′ ″	Difference. ′ ″
39500	169 48 9	2 38	52000	170 42 11	3 38	65000	171 22 31	2 42	77000	171 51 10	2 9	89000	172 14 20	1 47
40000	169 50 44	2 35	53000	170 45 45	3 34	66000	171 25 9	2 38	78000	171 53 16	2 6	90000	172 16 4	1 44
41000	169 55 45	5 1	54000	170 49 13	3 28	67000	171 27 45	2 36	79000	171 55 20	2 4	91000	172 17 48	1 44
42000	170 0 38	4 53	55000	170 52 37	3 24	68000	171 30 17	2 32	80000	171 57 21	2 1	92000	172 19 30	1 42
43000	170 5 21	4 43	56000	170 55 56	3 19	69000	171 32 47	2 30	81000	171 59 20	1 59	93000	172 21 10	1 40
44000	170 9 58	4 37	57000	170 59 9		70000	171 35 14	2 27	82000	172 1 19	1 59	94000	172 22 49	1 39
45000	170 14 24	4 26	58000	171 2 19	3 10	71000	171 37 39	2 25	83000	172 3 16	1 57	95000	172 24 27	1 38
46000	170 18 44	4 20	59000	171 5 24	3 5	72000	171 40 1	2 22	84000	172 5 11	1 55	96000	172 26 3	1 36
47000	170 22 55	4 11	60000	171 8 25	3 1	73000	171 42 20	2 19	85000	172 7 5	1 54	97000	172 27 37	1 34
48000	170 27 0	4 5	61000	171 11 21	2 56	74000	171 44 36	2 16	86000	172 8 56	1 51	98000	172 29 9	1 32
49000	170 30 58	3 58	62000	171 14 13	2 52	75000	171 46 50	2 14	87000	172 10 45	1 49	99000	172 30 40	1 31
50000	170 34 49	3 51	63000	171 17 3	2 50	76000	171 49 1	2 11	88000	172 12 33	1 48	100000	172 32 9	1 29
51000	170 38 33	3 44	64000	171 19 49	2 46									

Table II. *Of the Parabolic Descent of a Comet towards the Sun.*

Dist.	Days.	Difference.	D. H. M. S.	Dist	Days.	Difference.	D. H. M. S.	Dist.	Days.	Difference.	D. H. M. S.
0.00	0.000000		0 0 0 0	0.40	6.932690		6 22 23 4	0.80	19.608610		19 14 36 24
0.01	0.027404	0.027404	0 0 39 28	0.41	7.194285	0.261595	7 4 39 46	0.81	19.977415	0.368805	19 23 27 29
0.02	0.077504	0.050100	0 1 51 36	0.42	7.459088	0.264803	7 11 1 5	0.82	20.348506	0.371091	20 8 21 54
0.03	0.142461	0.064957	0 3 25 9	0.43	7.727064	0.267976	7 17 26 58	0.83	20.721870	0.373364	20 17 19 29
0.04	0.219231	0.076770	0 5 15 42	0.44	7.998173	0.271109	7 23 57 22	0.84	21.097484	0.375614	21 2 20 23
0.05	0.306384	0.087153	0 7 21 12	0.45	8.272381	0.274208	8 6 32 14	0.85	21.475344	0.377860	21 11 24 29
0.06	0.402773	0.096389	0 9 39 59	0.46	8.549654	0.277273	8 13 11 30	0.86	21.855435	0.380091	21 20 31 49
0.07	0.507634	0.104861	0 12 11 0	0.47	8.829957	0.280303	8 19 55 8	0.87	22.237737	0.382302	22 5 42 20
0.08	0.620079	0.112445	0 14 52 55	0.48	9.113257	0.283300	9 2 43 5	0.88	22.622250	0.384513	22 14 56 3
0.09	0.739904	0.119825	0 17 45 28	0.49	9.399525	0.286268	9 9 35 19	0.89	23.008951	0.386701	23 0 12 53
0.10	0.866586	0.126682	0 20 47 53	0.50	9.688729	0.289204	9 16 31 46	0.90	23.397824	0.388873	23 9 32 52
0.11	0.997717	0.131131	0 23 56 43	0.51	9.980839	0.292110	9 23 32 24	0.91	23.788877	0.391053	23 18 55 59
0.12	1.136537	0.138820	1 3 16 37	0.52	10.275827	0.294988	10 6 37 11	0.92	24.182071	0.393194	24 4 22 11
0.13	1.284449	0.147912	1 6 49 36	0.53	10.573667	0.297840	10 13 46 5	0.93	24.577408	0.395337	24 13 51 28
0.14	1.435502	0.151053	1 10 27 7	0.54	10.874332	0.300665	10 20 59 2	0.94	24.974876	0.397468	24 23 23 49
0.15	1.592021	0.156519	1 14 12 31	0.55	11.177787	0.303455	11 4 16 1	0.95	25.374483	0.399607	25 8 59 16
0.16	1.753847	0.161826	1 18 5 32	0.56	11.484018	0.306231	11 11 36 59	0.96	25.776184	0.401701	25 18 37 42
0.17	1.920813	0.166966	1 22 5 58	0.57	11.792993	0.308975	11 19 1 55	0.97	26.179982	0.403798	26 4 19 10
0.18	2.092765	0.171952	2 2 13 35	0.58	12.104695	0.311702	12 2 30 46	0.98	26.585866	0.405884	26 14 3 39
0.19	2.269563	0.176798	2 6 28 10	0.59	12.419090	0.314395	12 10 3 29	0.99	26.993835	0.407969	26 23 51 7
0.20	2.451076	0.181513	2 10 49 33	0.60	12.736164	0.317074	12 17 40 5	1.00	27.403864	0.410029	27 9 41 34
0.21	2.637186	0.186110	2 15 17 33	0.61	13.055891	0.319727	13 1 20 29	1.01	27.815951	0.412087	27 19 34 58
0.22	2.827781	0.190595	2 19 52 0	0.62	13.378251	0.322360	13 8 4 41	1.02	28.230078	0.414127	28 5 31 19
0.23	3.022759	0.194978	3 0 32 6	0.63	13.703217	0.324966	13 16 52 38	1.03	28.646240	0.416162	28 15 30 34
0.24	3.222230	0.199471	3 5 20 1	0.64	14.030779	0.327562	14 0 44 19	1.04	29.064425	0.418185	29 1 32 46
0.25	3.425483	0.203253	3 10 12 42	0.65	14.360903	0.330124	14 8 39 42	1.05	29.484640	0.420215	29 11 37 52
0.26	3.633053	0.207570	3 15 11 36	0.66	14.693577	0.332674	14 16 38 45	1.06	29.906846	0.422206	29 21 45 52
0.27	3.844656	0.211603	3 20 16 18	0.67	15.028796	0.335219	15 0 41 28	1.07	30.331041	0.424195	30 7 56 42
0.28	4.060213	0.215557	4 1 26 42	0.68	15.366505	0.337709	15 8 47 46	1.08	30.757252	0.426211	30 18 10 16
0.29	4.279655	0.219442	4 6 42 42	0.69	15.706713	0.340208	15 16 57 40	1.09	31.185413	0.428161	31 4 27 0
0.30	4.502914	0.223259	4 12 4 12	0.70	16.049401	0.342688	16 1 11 8	1.10	31.615553	0.430140	31 14 46 24
0.31	4.729926	0.227012	4 17 31 6	0.71	16.394541	0.345140	16 9 28 8	1.11	32.047661	0.432108	32 1 8 38
0.32	4.960632	0.230706	4 23 3 19	0.72	16.742121	0.347580	16 17 48 39	1.12	32.481705	0.434044	32 11 33 39
0.33	5.194964	0.234332	5 4 40 45	0.73	17.092126	0.350005	17 2 12 40	1.13	32.917695	0.435990	32 22 1 16
0.34	5.432880	0.237916	5 10 23 21	0.74	17.444532	0.352406	17 10 40 7	1.14	33.355622	0.437927	33 8 32 6
0.35	5.674320	0.241440	5 16 11 1	0.75	17.799332	0.354800	17 19 11 2	1.15	33.795471	0.439849	33 19 5 29
0.36	5.919234	0.244914	5 22 3 42	0.76	18.156505	0.357173	18 3 45 22	1.16	34.237242	0.441771	34 5 41 38
0.37	6.167573	0.248339	6 4 1 18	0.77	18.516027	0.359522	18 12 23 5	1.17	34.680919	0.443677	34 16 20 31
0.38	6.419145	0.251572	6 10 3 34	0.78	18.877901	0.361874	18 21 4 11	1.18	35.126496	0.445577	35 3 2 9
0.39	6.674346	0.255201	6 16 11 3	0.79	19.242097	0.364196	19 5 48 37	1.19	35.573967	0.447471	35 13 46 19
0.40	6.932690	0.258344	6 22 23 4	0.80	19.608610	0.366513	19 14 36 24	1.20	36.023308	0.449341	36 0 33 34

TABLE II. *Of the Parabolic Descent of a Comet towards the Sun.—Continued.*

Dist.	Days.	Differ.	D.	H.	M.	S.	Dist.	Days.	Differ.	D.	H.	M.	S.	Dist.	Days.	Differ.	D.	H.	M.	S.
1.20	36.023308		36	0	33	34	1.80	66.179041		66	4	17	49	2.40	101.88933		101	21	20	38
1.21	36.474454	0.451146	36	11	23	12	1.81	66.731321	0.552280	66	17	33	6	2.41	102.52678	0.63745	102	12	38	34
1.22	36.927637	0.453183	36	22	15	48	1.82	67.285101	0.553780	67	6	50	33	2.42	103.16559	0.63881	103	3	58	27
1.23	37.382590	0.454953	37	9	10	56	1.83	67.840406	0.555305	67	19	34	11	2.43	103.80569	0.64010	103	19	20	12
1.24	37.839408	0.456818	37	20	8	45	1.84	68.397386	0.556980	68	9	32	14	2.44	104.44712	0.64142	104	10	43	51
1.25	38.298059	0.458651	38	7	9	9	1.85	68.955556	0.558170	68	22	56	0	2.45	105.08988	0.64276	105	2	7	51
1.26	38.758546	0.460487	38	18	12	18	1.86	69.515408	0.559852	69	12	22	11	2.46	105.73395	0.64407	105	17	36	53
1.27	39.220876	0.462330	39	5	18	4	1.87	70.076790	0.561382	70	1	50	35	2.47	106.37905	0.64510	106	9	5	50
1.28	39.685037	0.464161	39	16	26	26	1.88	70.639642	0.562852	70	15	21	5	2.48	107.02600	0.64695	107	0	37	27
1.29	40.150998	0.465961	40	3	37	26	1.89	71.204016	0.564374	71	4	53	47	2.49	107.67395	0.64795	107	16	10	29
1.30	40.618765	0.467767	40	14	51	1	1.90	71.769884	0.565868	71	18	28	38	2.50	108.32328	0.64933	108	7	45	31
1.31	41.088354	0.469589	41	2	7	14	1.91	72.337233	0.567349	72	8	2	1	2.51	108.97383	0.65055	108	13	22	19
1.32	41.559723	0.471369	41	13	26	0	1.92	72.906057	0.568824	72	21	44	43	2.52	109.62573	0.65190	109	15	1	4
1.33	42.032885	0.473162	42	0	47	20	1.93	73.476379	0.570322	73	11	25	59	2.53	110.27891	0.65318	110	6	41	38
1.34	42.507838	0.474953	42	12	11	17	1.94	74.048160	0.571781	74	1	9	21	2.54	110.93338	0.65447	110	22	24	4
1.35	42.984564	0.476726	42	23	37	46	1.95	74.621460	0.573300	74	14	54	54	2.55	111.58918	0.65580	111	14	8	25
1.36	43.463043	0.478479	43	11	6	47	1.96	75.196205	0.574745	75	4	42	32	2.56	112.24623	0.65705	112	5	54	34
1.37	43.943300	0.480257	43	22	38	21	1.97	75.772408	0.576203	75	18	32	16	2.57	112.90454	0.65831	112	21	42	32
1.38	44.425307	0.482007	44	10	12	27	1.98	76.350105	0.577697	76	8	24	9	2.58	113.56416	0.65962	113	13	32	23
1.39	44.909069	0.483762	44	21	49	4	1.99	76.929238	0.579133	76	22	18	6	2.59	114.22508	0.66092	114	5	24	7
1.40	45.394556	0.485487	45	9	28	6	2.00	77.509839	0.580601	77	12	14	10	2.60	114.88721	0.66213	114	21	17	35
1.41	45.881795	0.487239	45	21	9	47	2.01	78.091889	0.582050	78	2	12	19	2.61	115.55069	0.66348	115	13	13	0
1.42	46.370759	0.488964	46	8	53	54	2.02	78.675399	0.583510	78	16	12	34	2.62	116.21540	0.66471	116	5	10	2
1.43	46.861456	0.490697	46	20	40	30	2.03	79.260310	0.584911	79	6	14	51	2.63	116.88138	0.66598	116	21	9	11
1.44	47.353871	0.492415	47	8	29	34	2.04	79.846728	0.586418	79	20	19	17	2.64	117.54862	0.66724	117	13	10	1
1.45	47.848004	0.494133	47	20	21	8	2.05	80.434531	0.587803	80	10	25	43	2.65	118.21719	0.66857	118	5	12	45
1.46	48.343826	0.495822	48	8	15	7	2.06	81.023806	0.589275	81	0	34	15	2.66	118.88693	0.66974	118	21	17	11
1.47	48.841360	0.497534	48	20	11	34	2.07	81.614474	0.590668	81	14	44	51	2.67	119.55808	0.67110	119	13	23	34
1.48	49.340590	0.499230	49	8	17	39	2.08	82.206610	0.592136	82	4	57	31	2.68	120.23033	0.67230	120	5	31	41
1.49	49.841514	0.500924	49	20	11	47	2.09	82.800172	0.593562	82	19	12	15	2.69	120.90386	0.67353	120	21	41	34
1.50	50.344114	0.502600	50	8	15	31	2.10	83.395125	0.594953	83	9	29	0	2.70	121.57870	0.67484	121	13	53	20
1.51	50.848374	0.504260	50	20	21	40	2.11	83.991509	0.596384	83	23	47	46	2.71	122.25473	0.67603	122	6	6	49
1.52	51.354338	0.505964	51	8	30	15	2.12	84.589337	0.597828	84	14	8	39	2.72	122.93203	0.67730	122	22	22	8
1.53	51.861959	0.507621	51	20	41	13	2.13	85.188549	0.599212	85	4	31	31	2.73	123.61060	0.67857	123	14	39	16
1.54	52.371230	0.509271	52	8	54	34	2.14	85.789172	0.600623	85	18	56	24	2.74	124.29043	0.67983	124	6	58	13
1.55	52.882178	0.510948	52	21	10	20	2.15	86.391195	0.602023	86	9	24	24	2.75	124.97143	0.68100	124	23	18	51
1.56	53.394767	0.512589	53	9	28	28	2.16	86.994600	0.603405	86	23	52	13	2.76	125.65372	0.68229	125	15	41	21
1.57	53.908994	0.514227	53	21	48	57	2.17	87.599435	0.604835	87	14	23	11	2.77	126.33726	0.68354	126	8	5	39
1.58	54.424874	0.515880	54	10	11	49	2.18	88.205671	0.606236	88	4	56	10	2.78	127.02203	0.68477	127	0	31	44
1.59	54.942351	0.517477	54	22	36	59	2.19	88.813272	0.607601	88	19	31	7	2.79	127.70800	0.68597	127	16	59	31
1.60	55.461520	0.519169	55	11	4	35	2.20	89.422288	0.609016	89	10	8	6	2.80	128.39518	0.68718	128	9	29	4
1.61	55.982281	0.520761	55	23	34	29	2.21	90.032692	0.610404	90	0	47	5	2.81	129.08362	0.68844	129	2	0	25
1.62	56.504668	0.522387	56	12	6	43	2.22	90.644468	0.611776	90	15	28	2	2.82	129.77330	0.68968	129	18	33	33
1.63	57.028661	0.523993	57	0	41	16	2.23	91.257605	0.613137	91	6	10	57	2.83	130.46421	0.69091	130	11	8	27
1.64	57.554265	0.525604	57	13	18	19	2.24	91.872135	0.614530	91	20	55	52	2.84	131.15630	0.69209	131	3	45	4
1.65	58.081471	0.527206	58	1	57	19	2.25	92.488021	0.615886	92	11	42	45	2.85	131.84967	0.69337	131	20	23	31
1.66	58.610297	0.528826	58	14	38	50	2.26	93.105300	0.617279	93	2	31	38	2.86	132.54422	0.69455	132	13	3	41
1.67	59.140709	0.530412	59	3	22	37	2.27	93.723952	0.618652	93	17	22	29	2.87	133.24000	0.69578	133	5	45	36
1.68	59.672706	0.531997	59	16	8	42	2.28	94.343935	0.619983	94	8	15	16	2.88	133.93697	0.69697	133	22	29	14
1.69	60.206283	0.533577	60	2	57	3	2.29	94.965313	0.621378	94	23	10	3	2.89	134.63516	0.69819	134	15	14	38
1.70	60.741441	0.535158	60	17	47	41	2.30	95.588022	0.622709	95	14	6	45	2.90	135.33459	0.69943	135	8	1	49
1.71	61.278185	0.536744	61	6	40	35	2.31	96.212119	0.624097	96	5	5	27	2.91	136.03519	0.70060	136	0	50	41
1.72	61.816501	0.538316	61	19	35	46	2.32	96.837550	0.625431	96	20	6	4	2.92	136.73697	0.70178	136	17	41	14
1.73	62.356379	0.539878	62	8	33	11	2.33	97.464305	0.626755	97	11	8	36	2.93	137.44003	0.70306	137	10	33	39
1.74	62.897826	0.541447	62	21	32	52	2.34	98.092460	0.628155	98	2	13	8	2.94	138.14419	0.70416	138	3	27	38
1.75	63.440819	0.542993	63	10	34	47	2.35	98.721932	0.629472	98	17	19	35	2.95	138.84965	0.70546	138	20	23	30
1.76	63.985390	0.544571	63	23	38	58	2.36	99.352723	0.630791	99	8	27	55	2.96	139.55626	0.70661	139	13	21	1
1.77	64.531486	0.546096	64	12	45	21	2.37	99.984862	0.632139	99	23	38	12	2.97	140.26406	0.70780	140	6	20	15
1.78	65.079145	0.547659	65	1	53	58	2.38	100.61838	0.63352	100	14	50	28	2.98	140.97310	0.70904	140	23	21	16
1.79	65.628323	0.549178	65	15	4	47	2.39	101.25318	0.63480	101	6	4	35	2.99	141.68329	0.71019	141	16	23	56
1.80	66.179041	0.550718	66	4	17	49	2.40	101.88933	0.63615	101	21	20	38	3.00	142.39462	0.71133	142	9	28	15

Table II. *Of the Parabolic Descent of a Comet towards the Sun.—Continued.*

Dist.	Days.	Differ.	D.	H.	M.	S.	Dist.	Days.	Differ.	D.	H.	M.	S.	Dist.	Days.	Differ.	D.	H.	M.	S.
3.00	142.39462		142	9	28	15	3.60	187.18265		187	4	23	1	4.20	235.87705		235	21	2	57
3.01	143.10720	0.71258	143	2	34	22	3.61	187.96313	0.78048	187	23	6	54	4.21	236.71995	0.84290	236	17	16	44
3.02	143.82093	0.71373	143	19	42	8	3.62	188.74465	0.78152	188	17	52	18	4.22	237.56388	0.84393	237	13	31	59
3.03	144.53586	0.71493	144	12	51	38	3.63	189.52730	0.78265	189	12	39	19	4.23	238.40882	0.84494	238	9	48	42
3.04	145.25203	0.71617	145	6	2	56	3.64	190.31100	0.78370	190	7	27	50	4.24	239.25477	0.84595	239	6	6	52
3.05	145.96930	0.71727	145	23	15	48	3.65	191.09575	0.78475	191	2	17	53	4.25	240.10163	0.84686	240	2	26	21
3.06	146.68778	0.71848	146	16	30	24	3.66	191.88162	0.78587	191	21	9	32	4.26	240.94961	0.84798	240	22	47	26
3.07	147.40741	0.71963	147	9	46	40	3.67	192.66860	0.78698	192	16	2	47	4.27	241.79850	0.84889	241	19	9	50
3.08	148.12824	0.72083	148	3	4	40	3.68	193.45658	0.78798	193	10	57	29	4.28	242.64844	0.84994	242	15	33	45
3.09	148.85024	0.72200	148	20	24	21	3.69	194.24567	0.78909	194	5	53	46	4.29	243.49927	0.85083	243	11	58	57
3.10	149.57338	0.72314	149	13	45	40	3.70	195.03581	0.79014	195	0	51	34	4.30	244.35122	0.85195	244	8	25	45
3.11	150.29779	0.72441	150	7	8	49	3.71	195.82705	0.79124	195	19	50	57	4.31	245.20406	0.85284	245	4	53	51
3.12	151.02321	0.72542	151	0	33	25	3.72	196 61928	0.79223	196	14	51	46	4.32	246.05784	0.85378	246	1	23	18
3.13	151.74983	0.72662	151	17	59	45	3.73	197.41264	0.79336	197	9	54	12	4.33	246.91280	0.85496	246	21	54	26
3.14	152.47763	0.72780	152	11	27	47	3.74	198.20709	0.79445	198	4	58	13	4.34	247.76863	0.85583	247	18	26	50
3.15	153.20660	0.72897	153	4	57	30	3.75	199.00255	0.79546	199	0	3	40	4.35	248.62546	0.85683	248	15	0	40
3.16	153.93678	0.73018	153	22	28	58	3.76	199.79908	0.79653	199	19	10	41	4.36	249.48335	0.85789	249	11	36	1
3.17	154.66807	0.73129	154	16	2	1	3.77	200.59665	0.79757	200	14	19	10	4.37	250.34212	0.85877	250	8	12	39
3.18	155.40050	0.73243	155	9	36	43	3.78	201.39537	0.79872	201	9	29	20	4.38	251.20192	0.85980	251	4	50	46
3.19	156.13411	0.73361	156	3	13	7	3.79	202.19505	0.79968	202	4	40	52	4.39	252.06263	0.86071	252	1	30	11
3.20	156.86889	0.73478	156	20	51	12	3.80	202.99580	0.80075	202	23	53	57	4.40	252.92440	0.86177	252	22	11	8
3.21	157.60476	0.73587	157	14	30	51	3.81	203.79770	0.80190	203	19	8	41	4.41	253.78718	0.86278	253	18	53	32
3.22	158.34180	0.73704	158	8	12	11	3.82	204.60061	0.80291	204	14	24	53	4.42	254.65089	0.86371	254	15	37	17
3.23	159.07996	0.73816	159	1	55	9	3.83	205.40452	0.80391	205	9	42	31	4.43	255.51556	0.86467	255	12	22	25
3.24	159.81929	0.73933	159	19	39	47	3.84	206.20948	0.80496	206	5	1	39	4.44	256.38130	0.86574	256	9	9	4
3.25	160.55982	0.74053	160	13	26	9	3.85	207.01548	0.80600	207	0	22	18	4.45	257.24789	0.86659	257	5	56	58
3.26	161.30141	0.74159	161	7	14	2	3.86	207.82257	0.80709	207	19	44	30	4.46	258.11556	0.86767	258	2	46	25
3.27	162.04415	0.74274	162	1	3	35	3.87	208.63072	0.80815	208	15	8	15	4.47	258.98406	0.86850	258	23	37	3
3.28	162.78806	0.74391	162	18	54	48	3.88	209.43986	0.80914	209	10	33	24	4.48	259.85365	0.86959	259	20	29	15
3.29	163.53308	0.74502	163	12	47	38	3.89	210.25010	0.81024	210	6	0	9	4.49	260.72418	0.87053	260	17	22	49
3.30	164.27920	0.74612	164	6	42	3	3.90	211.06134	0.81124	211	1	28	20	4.50	261.59566	0.87148	261	14	17	45
3.31	165.02653	0.74733	165	0	38	12	3.91	211.87363	0.81229	211	20	58	2	4.51	262.46806	0.87240	262	11	26	0
3.32	165.77496	0.74843	165	18	35	57	3.92	212.68698	0.81335	212	16	29	15	4.52	263.34154	0.73348	263	8	11	49
3.33	166.52450	0.74954	166	12	35	17	3.93	213.50130	0.81432	213	12	1	52	4.53	264.21600	0.87446	264	5	11	2
3.34	167.27515	0.75065	167	6	36	13	3.94	214.31674	0.81544	214	7	36	6	4.54	265.09137	0.87537	265	2	11	34
3.35	168.02696	0.75181	168	0	38	49	3.95	215.13315	0.81641	215	3	11	4	4.55	265.96767	0.87630	265	23	13	27
3.36	168.77989	0.75293	168	18	43	2	3.96	215.95070	0.81755	215	22	49	1	4.56	266.84500	0.87733	266	20	16	48
3.37	169.53390	0.75401	169	12	48	49	3.97	216.76914	0.81844	216	18	27	34	4.57	267.72324	0.87824	267	17	21	28
3.38	170.28910	0.75520	170	6	56	18	3.98	217.58875	0.81961	217	14	7	48	4.58	268.60243	0.87919	268	14	27	30
3.39	171.04536	0.75626	171	1	5	19	3.99	218.40930	0.82055	218	9	49	24	4.59	269.48260	0.88017	269	11	34	57
3.40	171.80271	0.75735	171	19	15	54	4.00	219.23091	0.82161	219	5	32	30	4.60	270.36380	0.88120	270	8	43	52
3.41	172.56133	0.75861	172	13	28	18	4.01	220.05356	0.82265	220	1	17	8	4.61	271.24588	0.88208	271	5	54	4
3.42	173.32094	0.75962	173	7	42	3	4.02	220.87715	0.82359	220	21	3	6	4.62	272.12900	0.88312	272	3	5	46
3.43	174.08160	0.76066	174	1	57	30	4.03	221.70181	0.82466	221	16	50	37	4.63	273.01294	0.88394	273	0	18	38
3.44	174.84344	0.76184	174	20	14	33	4.04	222.52756	0.82575	222	12	39	41	4.64	273.89794	0.88500	273	21	33	2
3.45	175.60640	0.76296	175	14	33	13	4.05	223.35426	0.82670	223	8	30	8	4.65	274.78383	0.88589	274	18	48	43
3.46	176.37049	0.76409	176	8	53	30	4.06	224.18200	0.82774	224	4	22	5	4.66	275.67070	0.88687	275	16	5	49
3.47	177.13565	0.76516	177	3	15	20	4.07	225.01083	0.82883	225	0	15	36	4.67	276.55856	0.88786	276	13	24	20
3.48	177.90194	0.76629	177	21	38	48	4.08	225 84063	0.82980	225	20	10	31	4.68	277.44730	0.88874	277	10	44	7
3.49	178.66930	0.76736	178	16	3	48	4.09	226.67142	0.83079	226	16	6	50	4.69	278.33707	0.88977	278	8	5	23
3.50	179.43771	0.76841	179	10	30	18	4.10	227.50326	0.83184	227	12	4	42	4.70	279.22777	0.89070	279	5	27	59
3.51	180.20729	0.76958	180	4	58	30	4.11	228.33605	0.83279	228	8	3	55	4.71	280.11935	0.89158	280	2	51	52
3.52	180.97800	0.77071	180	23	28	19	4.12	229.16990	0.83385	229	4	4	39	4.72	281.01190	0.89255	281	0	17	8
3.53	181.74975	0.77175	181	17	59	38	4.13	230.00474	0.83484	230	0	6	50	4.73	281.90539	0.89349	281	21	43	46
3.54	182.52259	0.77284	182	12	32	32	4.14	230.84056	0.83582	230	20	10	25	4.74	282.79987	0.89448	282	19	11	49
3.55	183.29650	0.77391	183	7	6	58	4.15	231.67748	0.83692	231	16	15	34	4.75	283.69533	0.89546	283	16	41	17
3.56	184.07159	0.77509	184	1	43	5	4.16	232.51537	0.83789	232	12	22	8	4.76	284.59165	0.89632	284	14	12	59
3.57	184.84770	0.77611	184	20	20	41	4.17	233.35432	0.83895	233	8	30	13	4.77	285.48900	0.89735	285	11	44	10
3.58	185.62490	0.77720	185	14	59	51	4.18	234.19427	0.83995	234	4	39	45	4.78	286.38721	0.89821	286	9	17	35
3.59	186.40321	0.77831	186	9	39	11	4.19	235.03515	0.84088	235	0	50	37	4.79	287.28633	0.89912	287	6	52	19
3.60	187.18265	0.77944	187	4	23	1	4.20	235.87705	0.84190	235	21	2	57	4.80	288.18647	0.90014	288	4	28	31

TABLE II. *Of the Parabolic Descent of a Comet towards the Sun.—Continued.*

Dist.	Days.	Differ.	D.	H.	M.	S.	Dist.	Days.	Differ.	D.	H.	M.	S.	Dist.	Days.	Differ.	D.	H.	M.	S.
4.80	288.18647		288	4	28	31	4.87	294.51361		294	12	19	36	4.94	300.88607		300	21	15	57
4.81	289.08753	0.90106	289	2	6	3	4.88	295.42107	0.90746	295	10	6	20	4.95	301.80028	0.91421	301	19	12	24
4.82	289.98953	0.90200	289	23	44	55	4.89	296.32966	0.90859	296	7	54	43	4.96	302.71521	0.91493	302	17	9	54
4.83	290.89240	0.90287	290	21	25	3	4.90	297.23904	0.90938	297	5	44	13	4.97	303.63121	0.91600	303	15	8	57
4.84	291.79630	0.90390	291	19	6	40	4.91	298.14945	0.91041	298	3	35	13	4.98	304.54793	0.91672	304	13	9	1
4.85	292.70107	0.90477	292	16	49	33	4.92	299.06075	0.91130	299	1	27	29	4.99	305.46570	0.91777	305	11	10	37
4.86	293.60681	0.90574	293	14	33	48	4.93	299.97296	0.91221	299	23	21	4	5.00	306.38449	0.91879	306	9	13	40
4.87	294.51361	0.90680	294	12	19	36	4.94	300.88607	0.91311	300	21	15	57							

TABLE III. *On the Elliptical Motion of Comets.*

Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.
0	000000	40	001719	80	004922	120	009161	160	014296	200	020260	240	027021	280	034568	320	042904
1	000007	41	001784	81	005016	121	009279	161	014437	201	020419	241	027200	281	034767	321	043123
2	000019	42	001850	82	005111	122	009397	162	014574	202	020579	242	027380	282	034966	322	043342
3	000035	43	001917	83	005207	123	009516	163	014715	203	020741	243	027560	283	035166	323	043562
4	000054	44	001985	84	005303	124	009636	164	014855	204	020900	244	027741	284	035366	324	043782
5	000075	45	002054	85	005399	125	009756	165	014997	205	021062	245	027922	285	035567	325	044002
6	000099	46	002124	86	005497	126	009876	166	015138	206	021224	246	028103	286	035768	326	044223
7	000125	47	002194	87	005595	127	009997	167	015281	207	021386	247	028285	287	035970	327	044445
8	000152	48	002265	88	005693	128	010119	168	015423	208	021549	248	028468	288	036172	328	044667
9	000182	49	002337	89	005792	129	010241	169	015567	209	021712	249	028651	289	036375	329	044890
10	000213	50	002409	90	005892	130	010364	170	015711	210	021876	250	028834	290	036578	330	045113
11	000246	51	002483	91	005993	131	010487	171	015855	211	022040	251	029018	291	036782	331	045337
12	000280	52	002557	92	006094	132	010611	172	016000	212	022205	252	029203	292	036986	332	045561
13	000316	53	002632	93	006195	133	010736	173	016145	213	022371	253	029388	293	037191	333	045786
14	000353	54	002707	94	006298	134	010861	174	016291	214	022536	254	029573	294	037396	334	046011
15	000392	55	002784	95	006400	135	010986	175	016437	215	022703	255	029759	295	037602	335	046236
16	000432	56	002861	96	006504	136	011112	176	016584	216	022869	256	029946	296	037808	336	046463
17	000473	57	002939	97	006608	137	011239	177	016731	217	023037	257	030133	297	038015	337	046689
18	000515	58	003017	98	006712	138	011382	178	016879	218	023205	258	030320	298	038222	338	046917
19	000559	59	003097	99	006818	139	011493	179	017028	219	023373	259	030508	299	038429	339	047144
20	000604	60	003177	100	006923	140	011622	180	017177	220	023542	260	030697	300	038637	340	047372
21	000650	61	003258	101	007030	141	011750	181	017326	221	023711	261	030886	301	038846	341	047601
22	000697	62	003339	102	007137	142	011879	182	017476	222	023881	262	031075	302	039055	342	047830
23	000745	63	003421	103	007245	143	012009	183	017626	223	024051	263	031265	303	039265	343	048060
24	000795	64	003504	104	007352	144	012140	184	017777	224	024222	264	031455	304	039475	344	048290
25	000845	65	003588	105	007461	145	012270	185	017929	225	024393	265	031646	305	039685	345	048521
26	000897	66	003672	106	007571	146	012402	186	018080	226	024565	266	031837	306	039896	346	048752
27	000949	67	003757	107	007680	147	012534	187	018233	227	024737	267	032029	307	040108	347	048984
28	001003	68	003843	108	007791	148	012666	188	018386	228	024910	268	032222	308	040320	348	049216
29	001057	69	003929	109	007902	149	012799	189	018539	229	025083	269	032415	309	040533	349	049449
30	001113	70	004016	110	008014	150	012932	190	018693	230	025257	270	032608	310	040746	350	049682
31	001169	71	004104	111	008126	151	013066	191	018848	231	025431	271	032802	311	040959	351	049916
32	001227	72	004192	112	008239	152	013201	192	019002	232	025606	272	032996	312	041173	352	050150
33	001285	73	004281	113	008357	153	013338	193	019158	233	025781	273	033191	313	041388	353	050385
34	001345	74	004371	114	008466	154	013473	194	019314	234	025957	274	033386	314	041603	354	050621
35	001405	75	004461	115	008580	155	013608	195	019470	235	026133	275	033582	315	041819	355	050857
36	001466	76	004552	116	008706	156	013744	196	019627	236	026309	276	033778	316	042035	356	051093
37	001528	77	004643	117	008811	157	013881	197	019784	237	026487	277	033975	317	042252	357	051330
38	001590	78	004736	118	008927	158	014016	198	019942	238	026664	278	034172	318	042469	358	051568
39	001654	79	004829	119	009044	159	014157	199	020101	239	026843	279	034370	319	042686	359	051806
40	001719	80	004922	120	009161	160	014296	200	020260	240	027021	280	034568	320	042904	360	052044

Table III. *On the Elliptical Motion of Comets.—Continued.*

Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.
360	052044	420	067321	480	084605	540	104101	600	126108	660	151055	720	179590	780	212741	840	252316
361	052283	421	067592	481	084911	541	104446	601	126498	661	151499	721	180101	781	213341	841	253046
362	052523	422	067864	482	085217	542	104792	602	126889	662	151944	722	180613	782	213943	842	253779
363	052763	423	068136	483	085525	543	105139	603	127281	663	152391	723	181127	783	214547	843	254515
364	053003	424	068409	484	085833	544	105486	604	127674	664	152837	724	181642	784	215152	844	255254
365	053244	425	068682	485	086141	545	105834	605	128067	665	153285	725	182158	785	215760	845	255997
366	053486	426	068956	486	086450	546	106183	606	128461	666	153734	726	182676	786	216369	846	256742
367	053728	427	069230	487	086760	547	106532	607	128857	667	154184	727	183194	787	216980	847	257490
368	053970	428	069505	488	087071	548	106882	608	129253	668	154635	728	183714	788	217592	848	258239
369	054213	429	069781	489	087382	549	107233	609	129649	669	155087	729	184236	789	218207	849	258991
370	054457	430	070057	490	087694	550	107585	610	130046	670	155540	730	184759	790	218823	850	259744
371	054701	431	070334	491	088006	551	107937	611	130445	671	155994	731	185283	791	219442	851	260500
372	054946	432	070611	492	088319	552	108290	612	130845	672	156449	732	185808	792	220062	852	261260
373	055191	433	070889	493	088632	553	108644	613	131245	673	156905	733	186335	793	220684	853	262035
374	055437	434	071168	494	088947	554	108998	614	131646	674	157363	734	186863	794	221308	854	262804
375	055684	435	071447	495	089262	555	109353	615	132048	675	157821	735	187392	795	221934	855	263575
376	055931	436	071726	496	089577	556	109709	616	132451	676	158280	736	187923	796	222562	856	264350
377	056178	437	072006	497	089893	557	110066	617	132855	677	158740	737	188455	797	223191	857	265128
378	056426	438	072287	498	090210	558	110423	618	133259	678	159202	738	188989	798	223823	858	265909
379	056674	439	072568	499	090527	559	110781	619	133664	679	159664	739	189524	799	224457	859	266692
380	056923	440	072850	500	090845	560	111140	620	134070	680	160128	740	190060	800	225093	860	267479
381	057172	441	073133	501	091144	561	111499	621	134477	681	160592	741	190598	801	225730	861	268270
382	057422	442	073416	502	091483	562	111859	622	134885	682	161058	742	191137	802	226368	862	269064
383	057673	443	073700	503	091802	563	112220	623	135294	683	161525	743	191677	803	227010	863	269861
384	057924	444	073984	504	092123	564	112582	624	135704	684	161992	744	192219	804	227655	864	270662
385	058176	445	074268	505	092445	565	112945	625	136114	685	162461	745	192763	805	228301	865	271466
386	058428	446	074553	506	092767	566	113308	626	136525	686	162931	746	193308	806	228948	866	272274
387	058680	447	074839	507	093088	567	113672	627	136938	687	163402	747	193854	807	229598	867	273085
388	058933	448	075126	508	093412	568	114037	628	137351	688	163874	748	194401	808	230250	868	273899
389	059187	449	075413	509	093736	569	114402	629	137765	689	164347	749	194950	809	230904	869	274717
390	059442	450	075701	510	094060	570	114768	630	138180	690	164822	750	195501	810	231561	870	275533
391	059696	451	075989	511	094385	571	115135	631	138596	691	165297	751	196053	811	232219	871	276364
392	059952	452	076278	512	094711	572	115502	632	139013	692	165774	752	196607	812	232879	872	277193
393	060208	453	076567	513	095037	573	115871	633	139430	693	166252	753	197162	813	233542	873	278025
394	060464	454	076857	514	095364	574	116240	634	139849	694	166731	754	197718	814	234207	874	278862
395	060721	455	077147	515	095692	575	116609	635	140268	695	167210	755	198276	815	234874	875	279702
396	060978	456	077439	516	096020	576	116980	636	140688	696	167691	756	198836	816	235543	876	280546
397	061236	457	077731	517	096349	577	117351	637	141109	697	168174	757	199397	817	236214	877	281394
398	061495	458	078023	518	096679	578	117723	638	141531	698	168657	758	199959	818	236888	878	282246
399	061754	459	078316	519	097009	579	118096	639	141955	699	169141	759	200524	819	237564	879	283102
400	062014	460	078609	520	097340	580	118470	640	142379	700	169626	760	201089	820	238241	880	283962
401	062274	461	078903	521	097672	581	118845	641	142803	701	170113	761	201656	821	238921	881	284826
402	062534	462	079198	522	098004	582	119220	642	143229	702	170602	762	202225	822	239604	882	285694
403	062796	463	079493	523	098337	583	119596	643	143656	703	171092	763	202796	823	240290	883	286567
404	063058	464	079789	524	098671	584	119973	644	144084	704	171582	764	203368	824	240978	884	287443
405	063320	495	080085	525	099005	585	120350	645	144512	705	172073	765	203941	825	241668	885	288324
406	063583	466	080382	526	099340	586	120728	646	144942	706	172565	766	204516	826	242360	886	289210
407	063846	467	080680	527	099676	587	121107	647	145372	707	173059	767	205093	827	243054	887	290099
408	064110	468	080978	528	100012	588	121487	648	145803	708	173554	768	205671	828	243752	888	290993
409	064375	469	081277	529	100349	589	121868	649	146236	709	174051	769	206251	829	244452	889	291892
410	064640	470	081577	530	100687	590	122250	650	146669	710	174548	770	206833	830	245154	890	292795
411	064905	471	081877	531	101025	591	122632	651	147103	711	175047	771	207416	831	245859	891	293702
412	065171	472	082178	532	101364	592	123015	652	147539	712	175547	772	208001	832	246566	892	294615
413	065437	473	082479	533	101704	593	123399	653	147975	713	176048	773	209587	833	247276	893	295532
414	065705	474	082781	534	102044	594	123783	654	148412	714	176550	774	209176	834	247988	894	296454
415	065973	475	083083	535	102385	595	124169	655	148850	715	177053	775	209766	835	248703	895	297381
416	066241	476	083386	536	102727	596	124555	656	149289	716	177558	776	210357	836	249420	896	298312
417	066510	477	083690	537	103070	597	124942	657	149729	717	178064	777	210950	837	250140	897	299248
418	066780	478	083994	538	103413	598	125330	658	150170	718	178572	778	211545	838	250863	898	300191
419	067050	479	084299	539	103757	599	125718	659	150612	719	179080	779	212142	839	251588	899	301138
420	067321	480	084605	540	104101	600	126108	660	151055	720	179590	780	212741	840	252316	900	302091

Table III. *On the Elliptical Motion of Comets.---Continued.*

Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.
900	302091	912	313957	923	325639	934	338267	945	352079	956	367460	967	384992	978	405921	989	433353
901	303047	913	314984	924	326745	935	339470	946	353404	957	368956	968	386728	979	408069	990	436444
902	304011	914	316018	925	327859	936	340681	947	354744	958	370451	969	388493	980	410270	991	439696
903	304980	915	317059	926	328981	937	341904	948	356097	959	371981	970	390288	981	412527	992	443135
904	305954	916	318107	927	330111	938	343137	949	357463	960	373530	971	392114	982	414845	993	446799
905	306933	917	319161	928	331250	939	344378	950	358843	961	375099	972	393972	983	417231	994	450737
906	307919	918	320223	929	332397	940	345635	951	360253	963	376691	973	395865	984	419687	995	455022
907	308913	919	321291	930	333553	941	346900	952	361668	963	378303	974	397795	985	422226	996	459763
908	309907	920	322369	931	334717	942	348177	953	363089	964	379939	975	399763	986	424850	997	465148
909	310910	921	323450	932	335891	943	349466	954	364530	965	381600	976	401771	987	427569	998	471539
910	3119[illegible]9	922	324541	933	337074	944	350766	955	365999	966	383289	977	403824	988	430386	999	479872
911	3129[illegible]4	923	325639	934	338267	945	352079	956	367460	967	384992	978	405921	989	433353	1000	500000
912	313957																

EXPLANATION OF THE TABLES.

Table I.

Explanation of Table I.

The use of this Table is to find the course of a comet, whose perihelion distance is equal to the radius of the earth's orbit. The first column contains the number of days since the comet passed its perihelion;—the second column contains the true anomaly of the comet, reckoned from the perihelion;—and the third column, the differences.

In order to adapt the Table to other parabolic orbits of any form, let the radius of the earth's orbit $= 1$, and the perihelion distance of the new orbit $= x$. Then if we multiply the number of days since the comet passed its perihelion in the first column by $x^{\frac{3}{2}}$, and enter the Table with this new number of days, we shall find in the opposite column the true anomaly corresponding to the given orbit.

On the contrary, if we wish to find from the given time after the passage of the perihelion, the time in the Table, and from this the true anomaly, we must divide the given time by $x^{\frac{3}{2}}$, in order to obtain the time in the Table.

Example.—If we suppose the perihelion distance of a comet to be $0.5835 = x$, and that its true anomaly is required 49 days, 18 hours, 55′ and 16″ after its passage of the perihelion. Then reducing the hours and minutes, &c. to decimals of a day, we shall have

$$\frac{49.78837}{(0.5835)^{\frac{3}{2}}} = 111.7034 \text{ days},$$

which may be found by logarithms in the following manner:

Log. of the perihelion distance 0.5835 . . .	9.7660409
Half of this logarithm	9.3830204
Three halves of the log. of the perihel. distance	9.6490613
Which being subtracted from 49.78837 days	1.6971279
There remains the log. of 111.7034 days . .	2.0480666

With 111.7034 days enter Table I. and corresponding to it will be found 90° 38′ 57″.4, the true anomaly of the comet 49.78837 days before and after its passage of the perihelion.

Table II.

Explanation of Table II.

The second Table is computed for the parabolic orbit of a comet whose perihelion distance is $= 0$, or whose orbit is a straight line. The first column contains the distances, the second and fourth the time, and the third the differences.

This Table is of very general use for all parabolic orbits, and serves to find the time in which a comet describes a given arch, when we know only the three sides of a triangle formed by lines drawn from the sun to the two extremities of the arch. One of these sides is the chord of the arch which we shall call c, and the other two sides which may be called a and b, are the radii vectors, or the distances of the comet from the sun. With these numbers find the values of

$$\frac{a+b+c}{2} = m$$

$$\frac{a+-c}{2} = n$$

With these values of m and n enter Table II. and take out the time from the second and fourth columns, and the difference of the times thus found is the time in which the comet would describe the given arch of a parabola.

Example.—Let $a = 1$; $b = 1$; $c = 2.2361$, then

$m = \dfrac{a+b+c}{2} = 2.61805$ which gives

in the Table	116.084 days

$n = \dfrac{a+b-c}{2} = 0.38195$ which gives

in the Table	6.467 days
	109.617 days

Hence the time in which the arch c is described is 109.6117 days, or 109 days, 14 hours, 48′.

In this Table the cubes of the numbers in the first column are proportional to the squares of the numbers in the second and fourth.

Comets ‖ Comma.

Explanation of Table III.

Table III.

This Table is computed for the elliptical orbits of comets, as the last was for parabolic orbits. The greater axis of the ellipse, determined in parts of the radius of the earth's orbit, is supposed to be known, and from this we may easily find, by the Table, the time of a revolution in days and decimals of a day.

The greater axis of the elliptical orbit is expressed in the following Table by 1000, and the time of a half revolution by 500,000, so that the time of a whole revolution will be 100,000. We have then only to make the following proportions:

1. As 1000 is to the greater axis of the elliptical orbit of the comet, so is the number contained in the first column of the Table to a fourth proportional, which will be the distance of the comet from the sun in parts of the radius of the earth's orbit.

2. As 100,000 is to the time of a complete revolution of a comet, so is the number contained in the second column of the Table to a fourth proportional, which will be the time, corresponding to the distance, expressed in days and decimals of a day.

Example.—Let the greater axis of the elliptical orbit of a comet be 6.287, and the time of a complete revolution 5.575 years, which was the case with the famous comet of 1770, the only one which is known to have moved in an elliptical orbit, and let the distance be 12, then we have

$$1000 : 6.287 = 12 : 0.075404,$$

the distance of the comet from the sun in parts of the radius of the earth's orbit; and

$$\text{Years.}\quad 100000 : 5.575 = 280 : 0.01561,$$

which is 5 days, 16 hours, 44′, the time which has elapsed since its passage of the perihelion, or the time which will elapse before it reaches its perihelion.

The preceding Tables were principally computed by M. Schulze. (*o*)

COMETARIUM, is the name of a machine invented by Dr Desaguliers, for explaining the phenomena of the motions of comets. The fullest and most perspicuous description of this machine will be found in Ferguson's *Astronomy*, vol. ii. p. 17.

COMETES, a genus of plants of the class tetrandria, and order Monogynia. See Botany, p. 126.

COMMA, in Music, is a name very anciently applied to the interval which is the difference between the major and the minor tone, and which is still very often used alone, without further addition, in musical writings; but which is not a commendable practice, for want of precision, since two other small intervals very often occur that pass also by this name, viz. the minor comma, and that of Pythagoras, besides a multitude of others, of less frequent occurrence or use, which different writers have called commas, as in the Table thereof which we have subjoined.

Comma *Major*, or *Comma* (*c*), is an interval whose ratio is $\frac{80}{81}$; the component primes of which are $\frac{2^4 5}{3^4}$; its common logarithm is .9946049,6811: in the binary logarithms of Euler, or decimal of an octave, it is .0179219O: it is the unit of the comma logarithms: where the schisma is the unit, it is = 11.0078624: in the new notation it is 11Σ + *m*: in the elements of perfect tune, it is = € + Σ: in diatonic elements, T—t, as before observed: in chromatic elements, 𝕊—𝒮: and in concordant, or tunable elements, it is 2 3^ds^ + III—2 4^ths^; where, on such an instrument as Mr Liston's organ, it may be correctly tuned, as it may more readily, and indeed is, in numerous instances on that organ, by 3 V—VIII—VI, by the help of perfect intervals only.

Comma.

The following equations exhibit the value of the *major comma*, in terms of all the several intervals in the Table, Plate XXX. of Vol. II. viz.

c = 11Σ + m
= € + Σ
= R + ƒc

c = T — t
= đ — Σ
= Ɛ — €
= S — L
= 𝕊 — 𝒮
= P — 𝕊
= 𝕊 — S
= 𝒮 — ƒ
= ſ — Ɛ
= ƒ — D
= D — χ
= π — ƒ€
= ∂ — π
= III — 2t

c = 10Σ + 3f + d
= 10Σ + f + F
= 5Σ + f + R
= 3Σ + r + R
= 2Σ + χ + R

c = 23Σ + 2m — đ
= 21Σ + 2m — €
= Σ + ƒ — π
= π + f — 2
= R + π — €
= Ɛ + π — ƒ
= Σ + φ — f
= R + ℝ — f
= Ɛ + f — φ
= F + φ — m
= P + S — T
= € + χ — r
= d + r — χ
= 11d + 33f — 10m
= 𝕋 + € — 2S
= 23 + III — 24

c = t — 2𝒮 — €
= ƒ — r — đ
= ſ — π — R
= 2Σ — π — r
= D — f — 3Σ
= π — f — 4Σ
= π — χ — Σ
= 2Ɛ — ƒ — R

By the help of this Table, the major comma can readily be expressed in any notation of three intervals, or of two when practicable. This interval is called the greater, syntonic, or elementary comma of various writers. It is also called a schism, or schisma, by Des Cartes, Holder, and others. It is the minor comma of Kollmann; and it is the enharmonious interval of Wood and Gregory. Intervals which are increased, sharpened, or made more acute by this interval (*c*), are said to be *acute*, and are marked with the acute accent (′), as an acute major third III′, by Overend, Maxwell, Liston, Farey, &c.; and intervals that are decreased, flattened, or made more grave by this interval (*c*), are said to be *grave*, and are marked with the grave accent (\`), as a grave minor third 3\`. These same marks, when affixed to letters of the scale, imply also the same thing, as A′, B\` are read A *acute*, B *grave*, &c. Chambers marks the acute and grave of intervals, or letters, by a dot placed over or under them, thus IİI, III, Ȧ, B, but which is far inferior in convenience to the above. By the same author, our grave or acute intervals are said to be *deficient* or *redundant* intervals. In our nomenclature, after Mr Overend, such are said to be *comma-deficient*, or *comma-redundant* intervals. M. Henfling calls our grave or acute intervals *inconcinnous ones*.

In his *Harmonics*, prop. 8. cor. 4. Dr Robert Smith gives a rule for finding a numerical ratio, extremely near to any fraction of the major comma, as $\frac{q}{p}c$, viz. $\frac{161p-q}{161p+q}$; thus $\frac{1}{11}c, = \frac{161\times 11-1}{161\times 11+1} = \frac{1770}{1772} = \frac{885}{886}$, is extremely near to $\frac{1}{11}$th of a comma, being 1.0007020 Σ, and $\frac{1}{11}c$ is 1.00071476 Σ, the difference of which is not more than $\frac{1}{78279}\Sigma$ or $\frac{1}{861826}c$, which would be absolutely imperceptible in the most delicate experiments in harmonics. The major comma is $\frac{1}{55.797636}$ VIII, $=73.55193\times f$, $=1400.0913\times m$, $=5.120743\times\tau$.

COMMA *Minor* (€), is an interval, the difference between two major semitones and a major tone, whose ratio is $\frac{2025}{2048}$; the component primes of which are $\frac{3^4 5^2}{2^{11}}$: its common logarithm is .9950950,7525: its binary, or Euler's logarithm, or decimal value of the octave, is =.01629381: in those where the major comma is the unit, =.9091561; and where the schisma is the unit, =10.0078624: in the new notation of Mr Farey, it is $10\Sigma+m$: in the elements of perfect tune, it is €: in diatonic elements, 2 S—T, as before observed: in chromatic elements it is S—𝕊: and, in corcordant or tunable elements, 3 4—III—3, or 3 4—V—2 III, or 3 VIII—2 III—4 V. According to which last method, this interval is tuned (between B and c♭) on Mr Liston's organ, as shewn in the *Philosophical Magazine*, vol. xxxvii. p. 275.

The following equations exhibit the value of the *minor comma*, in terms of all the several intervals in the Table, Plate XXX. of Vol. II. viz.

€=10Σ+m
= R+f€
= 3χ+d
€= c—Σ
= đ—2Σ
= ℰ—c
= ƒ—2c
=2c—đ
= S—𝕊
= L—𝒮
= S—P
= ƒ—π
= π—f€
= φ—f
= D—f€
= 𝒮—∂
=2S—T
= T—2𝕊
= 2ℰ—ƒ
€=9Σ+d+3f
=9Σ+F+f
=6Σ+F+χ
=4Σ+R+f
=2Σ+R+τ
= Σ+R+χ
€=21Σ+2m—c
= Σ+ ℰ—đ
= R+ 2r—f
= đ+ f—r
= c+ r—χ
= 5r+ m—5f
= π+ R—c
= π+ f—ℝ
= ƒ+ R—E
= T+ ℰ—T
= 2S+ c—T
= ƒ+ χ—ƒ
= 𝒮+ R—ƒ
=10d+30f—9m
€= ℰ— m—11Σ
= π— f—5Σ
= D— f—4Σ
= ƒ— ℰ—Σ
= ∂— π—Σ
= 𝕊— S—Σ
= 𝕋— T—Σ
= T— t—Σ
= 𝕋— P—𝕊
= t— S—∂
= t—2𝒮—c
= t— P—ƒ
=2S— P—∂
= L—3đ—f

This interval has been called the lesser comma by some: M. Chladni calls it a comma: it is the apotome minor of Salomon Delaus: the minor apotome of some writers: the diaschisma of Euler: the diesis major of Maxwell: the grave diesis, or grave diminished second, of Liston; and it is $=.3976837\times f$: it forms the interval between 23 of the adjacent notes in his scale. See *Philosophical Magazine*, vol xxxix, p. 373. M. Euler states it to be nearly the $\frac{1}{61}$st part of the octave.

COMMA *Maximum*, comma of Pythagoras, Boethius, &c. or ancient comma, is an interval whose ratio is $\frac{524288}{531441}$, $=12\Sigma+m$, or the DIASCHISMA (đ). This interval has also been called the comma syntonum, the comma ditonicum, and is the major comma of Kollmann.

COMMAS, *Various*. We shall now proceed to give, in a Tabular form, as in Plate XXX. vol. ii. some of the most useful particulars, of all the intervals which we have met with in musical writings, under the name of *Comma*, viz.

No.	Ratios, or Fractions.	Indices of the Primes 2	3 &	5	Common 11-place Logarithms.	New Notation. Σ	f.	m.	Binary Logarithms.	Comma Logarithms.
1	$\frac{32768}{32805}$	15	—8	—1	.9995098,9287	1.	0	0	.00162810	.09084418
2	$\frac{149831}{150000}$	. . . .	. . . .	. . . .	.9995104,3	0.998898	0	0		
3	. . . . .	. . . .	. . . .	. . . .	.9995081,2092	1.003615	0	0	.0016340	.0911726
4	$\frac{229}{230}$	. . . .	. . . .	. . . .	.9981076,4632	3.861102	0	0		
5	. . . . .	. . . .	. . . .	. . . .	.9981054,6213	3.865559	0	0	.0062935	.351163
6	$\frac{521441}{524288}$	. . . .	. . . .	. . . .	.9976352,	4.825125	0	0		
7	$\frac{125}{126}$	. . . .	. . . .	. . . .	.9965394,6789	7 052904	0	1		
8	$\frac{95}{96}$	. . . .	. . . .	. . . .	.9954523,7225	9.270982	0	1		
9	$\frac{2025}{2048}$	—11	4	2	.9950950,7525	10.	0	1	.0162933	.9091558
10	. . . . .	. . . .	. . . .	. . . .	.9948500,2168	10.5	0	1	.0171076	.9545785
11	. . . . .	. . . .	. . . .	. . . .	.9948321,03	10.536559	0	1		
12	$\frac{80}{81}$	4	—4	1	.9946049,6811	11.	0	1	.0179219	1.000000
13	. . . . .	. . . .	. . . .	. . . .	.9943942,5528	11.429932	0	1	.0186218	1.039058
14	. . . . .	. . . .	. . . .	. . . .	.9943415.7707	11.537415	0	1	.0187972	1.048822
15	. . . . .	. . . .	. . . .	. . . .	.9943201,8876	11.581055	0	1	.0188679	1.052786
16	. . . . .	. . . .	. . . .	. . . .	.9943163,8639	11.588813	0	1	.0188806	1 053490
17	. . . . .	. . . .	. . . .	. . . .	.9942803,1368	11.662416	0	1	.0190005	1.060176
18	. . . . .	. . . .	. . . .	. . . .	.9942190,5029	11.787416	0	1	.0192040	1.071532
19	$\frac{524288}{531441}$	19	—12	0	.9941148,6098	12.	0	1	.0195500	1.090843
20	. . . . .	. . . .	. . . .	. . . .	.9940904,1101	12.049887	0	1	.0196313	1.095377
21	$\frac{63}{64}$	. . . .	. . . .	. . . .	.9931605,7547	13.947095	0	1		1.2677
22	$\frac{4100625}{4194304}$	—22	8	4	.9901901,5050	20.	0	2	.0325876	1.818312
23	$\frac{125}{128}$	. . . .	. . . .	. . . .	.9897000,4336	21.	0	2	.0342153	1.909156
24	$\frac{6400}{6561}$	8	—8	2	.9892099,3622	22.	0	2	.0358438	2.000000
25	$\frac{35}{36}$	. . . .	. . . .	. . . .	.9877655,4358	24.947096	0	2		
26	$\frac{625}{648}$	—3	—4	4	.9843050.1147	32.	0	3	.0521376	2.909156

No. 1. in the above Table, is a comma mentioned by M. Chladni.—No. 2. is the comma minimum of some writers, it is the semi-comma minime of Rameau, but is our Schisma (Σ), which see.—No 3. is the $\frac{1}{612}$th part of the *octave*, and is the undecomma or artificial comma of Mr Farey, in that particular case where it measures the octave; see the *Phil Mag.* vol. xxxix. p. 420, and our article Common-measures of *Intervals*.—No. 4. is a comma of Philolaus, which he states to be very near to another comma, the $\frac{1}{27}$th part of a *tone-major*, which next follows No. 5.—No. 6. is a comma mentioned by Galileo, but owing to a mistake, in the numerical operation by which he derived it, otherwise he would have obtained the comma of Pythagoras (No. 19. in this Table), as Mr Overend has shewn in his manuscripts.—No. 7. is the smaller comma of M. Chladni.—No. 8. is a comma mentioned by M. Chladni; it is the error or flattening of the false minor third on the trumpet and horn; see Chromatic *French horn*.—No. 9. is the comma of M. Chladni and the lesser comma of some writers, it is our *Minor* Comma (€), already fully described.—No. 10. is the half of the *enharmonic diesis*, which Dr Callcott has called a comma.—No. 11. is the $\frac{1}{58.25}$th part of an *octave*, and is said to be the artificial comma of Mersennus, according to Dr Holder.—No. 12. is the *Major* Comma (c), of which we have fully treated.—No. 13. is $\frac{1}{5}$th of the *major semitone*, a comma of Boethius, and one which Dr Callcott mentions.—No. 14. is $\frac{1}{4}$th of the *limma*, and is another comma of Boethius.—No. 15. is the $\frac{1}{53}$d part of the *octave*, the artificial comma of N. Mercator, in that particular case where it measures the octave.—No. 16. is $\frac{1}{9}$th part of the *major tone*, and is another comma of Boethius, D. Nichola, &c. mentioned also by Dr Callcott.—No. 17. is the $\frac{1}{8}$th part of the *minor tone*, and is mentioned as a comma by Dr Callcott.—No. 18. is $\frac{1}{4}$th part of the *semitone medius*, and is another of the commas noticed by Dr Callcott.—No. 19. is the comma of Pythagoras, Boethius, &c. the ancient comma, the comma maximum of some writers; the comma syntonum, the comma diatonicum, and the major comma of Kollmann, but is our Diaschisma (đ), see that article.—No. 20. is the $\frac{1}{3}$d part of a *minor semitone*, that is mentioned as a comma by Dr Callcott.—No. 21. is a comma mentioned by M. Chladni, and is the error or flattening of the minor seventh on the trumpet and horn; see the article above quoted.—No. 22. is the double *minor comma*, and is = 2 €, = Ɛ − Σ = ʄ − đ. No. 23. is the comma greater of some writers, and one of the commas of M. Chladni, but it is our *Enharmonic* Diesis (Ɛ), which see.—No. 24. is the double *major comma*, and is = 2 c, = Ɛ + Σ, = ʄ − χ, = đ + €, = ʃ − c, = Ꞩ − ʄ, = P − Ꞩ, = 5 T + 2 S − VIII.—No. 25. is the bearing comma of Mr Holder.—And No. 26. is the ancient comma of Galileo and one of the commas of M. Chladni, and is = 2 c + €, = Ɛ + c, 3 € + 2 Σ, = Ꞩ − π, = S − ʄ = T − 2*t* + 2 S.

Comma *and Half.* Besides the above commas and artificial commas, &c. of authors, certain intervals have been called *comma and half*, we shall insert these as a continuation of the above Table, viz.

No. 27	$\frac{1953125}{1990656}$	−13	−5	9	.9917338,2182	{17. / 16.850339}	−1 / 0	2 / 2	.0274596	1.532183
28	$\frac{625}{648}$	− 3	−4	4	.9843050,1147	32.	0	3	.0521371	2.909156

No. 27 is called the comma and half by Rameau, and is = 16.866064 × Σ, = c + R, = đ + F + 4 Σ, = € + R + Σ, = c + F + 5 Σ, = € + F + 6 Σ, = ʃ − π, = Ɛ − ʄ€, = đ + R − Σ, = 4 € + 2 Σ − ʄ, = 2 S + Ꞩ − 4 Ꞩ, = T − 4 *t* + 5 S, = 5 3 − 4 III.—No. 28. is the comma and half of Galileo, and is our Semitone *minimum* (ʃ), which see: it is a repetition of No. 26, above.

Semi Commas various. The following have been called *Semi Commas*, viz.

29	$\frac{15552}{15625}$	6	5	−6	.9979662,2157	4.	1	0	.0067561	3769725
30	$\frac{2097152}{2109375}$	21	−3	−7	.9974761,1443	5.	1	0	.0083842	.4678167
31	$\frac{590625}{593216}$	−17	−1	8	.9971288,5368	{6. / 5.850339}	−1 / 0	1 / 1	.0095377	.5321834
32	$\frac{78125}{78732}$	− 2	−9	7	.9966387,4655	{7. / 6.850339}	−1 / 0	1 / 1	.0111659	.6230275

No. 29. is the Semi-comma *major* of Rameau (ʄ€), see that article: it occurs between two of the adjacent notes on Mr Liston's enharmonic scale, viz. between F′♭ and E′✕, and between B′♭♭ and A′✕, see the *Phil. Mag.* vol. xxxix. page 419.—No. 30. is the Semi-comma *maxime* of Rameau (ʄ c), see that article: it is also called a hyperoche by Dr Busby.—No. 31. is called, in the Callcott manuscripts in the library of the Royal Institution, the semi-comma minor of Rameau (but which is inconsistent with the *major* above), and is the eschaton of M. Henfling and Mr Travers: it is our *Major* Residual (R), which see.—No. 32, is the mean semi-comma of Rameau: its schisma logarithm is 6.858202; in elements of perfect tune it is ʄ + 3 € + 2 Σ; in diatonic elements 2 T − 4 *t* + 3 S; in chromatic elements S + 2 Ꞩ − 4 Ꞩ; and in concordant or tunable elements it is 6 3 − III − 3 4, by which it might be tuned, on Liston's organ, or any similar instrument if wanted. It is equal R + Σ, = F + 6 Σ, = ʃ − ʄ, = € − χ, &c. The above list, which might probably be extended, if our reading had been still more extensive, shews how necessary it is, for authors and readers of musical works, to be on their guard, as to the numerous and variable uses of the word *comma*. For want of this attention, and using No. 12, 15, and 19 indiscriminately in part of his writings, a late author on temperament, Mr Hawkes, has drawn some very erroneous conclusions, as to his own scale of temperament, as has been shewn in the Philosophical Magazine, vol. xxxvii. p. 321, and where he is stated to adopt the intermediate comma of the three above, as the foundation of his proceedings; and yet since that period, he is said to have changed his mind, and preferred the first comma or No. 12, according to which Mr Liston has calculated the temperaments of his system at page 22 of his "Essay on perfect Intonation," viz. the third of the schemes of temperament there given. With respect to *artificial commas*, it will be necessary to say something more par-

Commelina, Commensurable Intervals.

ticular, as to the invention and use of these apparently COMMON MEASURES *of musical ratios*; for which, see that article. (*e*)

COMMELINA, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 96.

COMMENSURABLE INTERVALS, in Music, are such only, whose ratios in numbers, have both their terms, *the same power* of some numbers respectively; as for instance, both the numerator and denominator of the fraction, or terms of the ratio, squares, both cubes, both biquadrates, numbers, &c.: in which case, the interval is an exact multiple of some other smaller interval: thus, in the Table in Plate XXX. Vol. II., the ratios answering to 4 ℰ and to 3 *f* are the only ones, whose numerator and denominator in col. 3. are both biquadrates, cubes, squares, or any other power, of any whole number whatever. In like manner, the indices of the primes 2, 3, and 5, in col. 4, and also the numbers of Σ, *f*, and *m*, in col. 6. respectively, are prime to each other, or have no common measure but unity, in any of the lines of the Table, except those of 4 ℰ and 3 *f*, above mentioned. And the same thing will hold, in the terms of any notation by 3 intervals, in which these or other intervals may be expressed. So that except the few intervals that are thus obviously *multiples* of some others, and ought not to have separate names, but be called double, triple, quadruple, &c. of their component intervals, as No. 22. in our Table of COMMAS (see that article) is the double minor comma, No. 24 is the double major comma, &c.

All useful or practicable musical intervals, are prime, or the terms of their ratios are irrational, or surd, towards each other; and strictly speaking, such a thing as a COMMON MEASURE (see that article) among musical intervals, is impossible. This general incommensurability of musical intervals arises from the very nature of the prime numbers of which their ratios are composed; of which primes it is demonstrable, that no finite power of one prime number can exactly equal any finite power whatever of any other prime number, nor can the multiples of any two produce a third prime number. And so, no number of any interval, can exactly equal any number of another prime or incommensurable interval, as most of those in practice are: for instance, no number of 3ds, IIIds, 4ths, Vths, 6ths, VIths, &c. can exactly make up an octave, or any number of such; no number of 3ds can make any number of Vths, nor can any number of IIIds do the same thing, &c. When it is said, that two intervals, or their ratios, are incommensurable, or prime to each other, it is by no means meant that all the numbers composing such ratios are *prime numbers*; indeed, that is seldom the case. Thus, if $\frac{8}{9}$ and $\frac{25}{27}$ are compared, all the *numbers* concerned are either squares or cubes, and yet these ratios are absolutely prime to each other. (*e*)

COMMENSURABLE SYSTEMS *of musical Intervals*; are such tempered systems of 7 notes or septaves, whose intervals being T, T, L, T, T, T, and L, (where $5\ T + 2\ L = \text{VIII}$), T has a finite or commensurable ratio to L; as suppose, T : L : : 8 : 5, then such an octave consists of $5 \times 8 + 2 \times 5 = 50$ equal parts, whereof the tone $= 8$, and the limma $= 5$ parts.

So in a system of 12 notes or douzeave, *l*, L, L, *l*, L, *l*, L, *l*, L, L, *l*, and L, (where $T - L = l$, and $7\ L + 5\ l = \text{VIII}$), if L is to *l* in any finite ratio, this also is a commensurable system; if for example, L : *l* :: 5 : 3, then $7 \times 5 + 5 \times 3 = 50$ parts in the octave, as above.

The 12 intervals above, being considered as between the notes C, C※, D, E♭, E, F, F※ G G※, A, B♭ B

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and *c*, constitute a regular douzeave; to which the notes of the octave next above, *c*※, *d*, *e*♭, *e*, *f*, *f*※, *g*, *g*※ *a*, &c. being joined, (each an exact octave above those in the given octave), then the consonances that can be taken *true*, or according to the intended system of temperament, are, as in the following Table, in part extracted from the *Philosophical Magazine*, vol. xxxix. p. 414, viz.

Consonances.	Bass and Treble Notes.	Regular Temperaments.
2	C※ D, DE♭, EF, F※ G, G※ A, AB♭, and B*c*	L
II	CD, DE, E♭F, EF※, FG, F※ G※, GA, AB, B♭ *c*, and B*c*※	L + *l*
3	CE♭, C※E, DF, EG, F※A, GB♭, G※B, A*c*, and B*d*	2 L + *l*
III	CE, DF※, E♭G, EG※, FA, GB, A*c*※, and B♭*d*	2 L + 2 *l*
4	CF, C※ F※, DG, EA, FB♭, F※B, G*c*, G※ *c*※, A*d*, B♭ *e*♭, and B*c* .	3 L + 2 *l*
IV	CF※, DG※, E♭A, FB, G*c*※, and B♭*e*	3 L + 3 *l*
V	CG, C※ G※, DA, E♭ B♭, EB, F*c*, F※ *c*※, G*d*, A*e*, B♭*f*, and B*f*※ .	4 L + 3 *l*
6	C※A, DB♭, E*c*, F※ *d*, G*e*♭, G※ *e*, A*f*, and B*g*	5 L + 3 *l*
VI	CA, DB, E♭*c*, E*c*※, F*d*, G*e*, A*f*※, B♭*g*, and B*g*※	5 L + 4 *l*
7	CB♭, C※B, D*c*, E*d*, F*e*♭, F※*e*, G*f*, G※ *f*※, A*g*, and B*a*	6 L + 4 *l*
VII	CB, D*c*※, E♭*d*, F*e*, G*f*※, A*g*※, and B♭*a*	6 L + 5 *l*

And the consonances that will result, or form *wolves*, on a douzeave instrument, for want of more than 12 strings or pipes, are as follows, viz.

Consonances.	Bass and Treble Notes.	Wolves.
2	CC※, E♭ E, FF※, GG※, and B♭ B	*l*
II	C※ E♭, and G※ B♭	2 L
3	E♭ F※, FG※, and B♭ *c*※	L + 2 *l*
III	C※ F, F※ B♭, G※ *c*, and B *e*♭ . .	3 L + *l*
4	E♭ G※	2 L + 3 *l*
IV	C※G, EB♭, F※*c*, G※*d*, A*e*♭, and B*f*	4 L + 2 *l*
V	G※ *e*♭	5 L + 2 *l*
6	CG※, E♭ B, F *c*※, and B♭ *f*※ . . .	4 L + 4 *l*
VI	C※ B♭, F※ *e*♭, and G※ *f*	6 L + 3 *l*
7	E♭ *c*※, and B♭ *g*※	5 L + 5 *l*
VII	C※ *c*, E *e*♭, F※ *f*, G※ *g*, and B *b*♭ .	7 L + 4 *l*

The above Tables, to which we shall frequently have occasion to refer, when treating on Tempered Systems, exhibits all the relations of the notes in a *regularly tempered system*, that is, wherein all the fifths, in modulating, either by flats or by sharps, from C (to G※ *e*♭, when there are but 12 notes,) are alike tempered, as far, at least, as the numbers of sounds in the octave will admit; and shews, that when L and *l* have a finite or commensurable ratio, all the intervals that can arise in the scale, being expressed in those terms, as in the last columns, are also finitely or commensurately related, in all *commensurable systems*. In the example of M. Henfling's system of 50 equal parts in the octave referred to above, since L = 5 and *l* = 3, the regularly tempered consonances 2, II, 3, III, &c. will be 5, 8, 13, 16, &c. of such equal parts; and the wolves of this system, on defective instruments, 2, II, 3, III, &c. will

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be 3, 10, 11, 18, &c. of such parts; the two series differing 2, or the major diesis L — l, in each case; for it will be observed, that the wolf always arises, by the substitution of L for l, or *vice versa*. And all such false intervals, called wolves, differ a major diesis (d) from the regularly tempered intervals of the same name or degree.

In commensurable systems, if the octave and any one other of the 22 intervals in the Tables, or any two among them be given, it will be easy to find the values of L and l therefrom, and thence the values of all the remainder of the 23 intervals: thus, if the octave be given = 50, (of any certain intervals or parts,) and the fifth = 29 (of the same parts,) then $7L + 5l = 50$, and $4L + 3l = 29$, whence $3L + 2l = 21$, and $L + l = 8$; $L = 8 - l$, and $24 - 3l + 2l = 21$, or $3 = l$, and $5 = L$; whence every thing else in the system may readily be found. So also, if the tempered III were given = 16 parts, and the VIth wolf = 39 parts, we have $2L + 2l = 16$, or $L + l = 8$, and $6L + 3l = 39$, or $2L + l = 13$; whence will be found $L = 5$ and $l = 3$, as before.

Merely giving the number of equal parts, into which the octave of a commensurate system is divided, is insufficient to determine that system, unless it be further given or assumed, that T and L, (and consequently L and l) are *whole numbers*, as Mr Farey has shewn in the *Philosophical Magazine*, vol. xxxviii. p. 435, and has there subjoined a general rule for finding all the possible and practicable answers to such questions, which rule (for T and L) we shall not repeat here, but give a similar one adapted to L and l, which will be found more useful, in conjunction with our Tables above. In the case of the octave divided into 50 equal parts, as before mentioned, all the possible integer values of L and l are as follows: viz.

$$\begin{array}{l} \quad\ \ \mathrm{L} \qquad\quad l \\ 7 \times 0 + 5 \times 10 = 50 \\ 7 \times 5 + 5 \times \ \ 3 = 50 \end{array}$$

And wherein it is plain that only the second line is applicable to a system of intervals, and gives L = 5 and l = 3, as before found.

Our general rule is as follows: viz. From the given number of equal parts (a) in the octave, deduct successively the multiples of 7, in the series 0, 7, 14, 21, 28, 35, &c. until a remainder is found divisible by 5, or which ends in 0 or 5, as all such numbers do, and let such multiple of 7, or subtrahend, be called b; then will $\frac{a-b}{5}$ be the greatest value of l, and $\frac{b}{7}$ the least, or corresponding value of L; and all other corresponding values of l will decrease from this by 7, and those L increase by 5, as in the example above.

Since L and l both represent half notes, or tones, it is plain that they can never, in practicable systems, differ much from each other, yet they never will coincide, except in the equal temperament, or isotonic system; and it will always be easy to select that line among the possible values of L and l, which answers the intended conditions. As another example, suppose the octave divided into 612 equal parts, or artificial commas of Farey, then

$$\begin{array}{r} \mathrm{L} \qquad\quad l \qquad\quad \\ 7 \times 1 + 5 \times 121 = 612 \\ 7 \times 6 + 5 \times 114 = 612 \\ 7 \times 11 + 5 \times 107 = 612 \\ 7 \times 16 + 5 \times 100 = 612 \\ 7 \times 21 + 5 \times 93 = 612 \\ 7 \times 26 + 5 \times 86 = 612 \\ 7 \times 31 + 5 \times 79 = 612 \\ 7 \times 36 + 5 \times 72 = 612 \\ 7 \times 41 + 5 \times 65 = 612 \\ 7 \times 46 + 5 \times 58 = 612 \\ 7 \times 51 + 5 \times 51 = 612 \\ 7 \times 56 + 5 \times 44 = 612 \\ \text{\&c.} \qquad\qquad \text{\&c.} \qquad \end{array}$$

shew the possible values of L and l: the last line but one shewing that 51 might answer for both L and l, each of which are, in such cases, the 12th part of the octave, for the isotonic or equal temperament system. The last line gives L = 56 and l = 44, which are in the ratio of 14 and 11, and answer also to 153 parts in the octave, &c. (ę)

COMMERCE.

Commerce.

COMMERCE is frequently used in the limited sense of "mercantile intercourse with a foreign country," while *trade* is made to denote "traffic among the inhabitants of the same country." Strictly speaking, however, there is no foundation for this distinction, either word being entitled, both by etymology and decisive authority, to a comprehensive and general interpretation. Either may therefore be defined, in the broadest sense, "an exchange of commodities, whether the object of the exchange be consumption or re-sale at a profit." We shall divide our discussion of this subject into three heads.

1. Historical sketch of commerce.
2. Present state of British commerce.
3. Observations on the principles of commerce.

History of Commerce.

I. *Historical sketch of commerce.*—The origin of commerce is involved in the same obscurity as the other occupations of an early stage of society. Its beginnings, like those of other things, must have been extremely rude, and must have consisted in nothing more than a barter of one simple article for another. In progress of time, certain articles of general utility, and which were capable of transportation, such as brass, iron, cattle, &c. became a kind of standard for the purchase of other commodities. Such appears to have been the case at the time of the Trojan war, and likewise, probably at the later period, when Homer composed his poem. A farther improvement in the mode of managing commerce, consisted in the adoption of gold and silver as money, or general representatives of value. This important point once established, it was easy to make the additional progress of stamping on the metal an official mark declaratory of its weight; and eventually, to constitute the mark, in the shape of coin, an indication of its fineness as well as of its weight. An attention to the different stages in the progress of currency, affords the inquirer a good criterion of the advance of commerce. In maritime countries a similar rule is offered by the progress of navigation. The conveyance of merchandize by water is, after mankind emerge from primitive ignorance, so much easier than by land, that we may safe-

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ly take for granted, that the people who possess opportunities of this description, without turning them to account, are very little advanced on the road to civilization.

Commerce of the Egyptians, &c.

In looking to historical documents for the first indications of commerce, the plan is to direct our attention to the earliest records of established society. These, as is well known, exist in the case of Assyria, Judæa, Egypt, and the surrounding countries. Here, accordingly, we find the descendants of Ishmael, "coming from Gilead, bearing spices, balm, and myrrh, going to carry it down to Egypt." In these days, merchants superintended the carriage of their own commodities, the expedient of transferring that duty to others, an arrangement so simple in our eyes, being incompatible with the rude customs of an unsettled people, and the difficulty of traversing an almost desert country. In Egypt, the progress of population, and consequently of commerce, appears to have been rapid, but not to have led to a correspondent improvement in navigation. However the national aversion to the sea being partially overcome, the Egyptians shared with the Phœnicians the honour of colonizing the far-famed shores of Greece.

Commerce of the Phœnicians.

The Phœnicians seem to have been early induced, by the convenience of their harbours, and the vicinity of timber, to make navigation a regular employment. It is common to ascribe their application to this pursuit, to the ungrateful nature of their soil; a consideration, which will not be received by those who examine with attention the causes of national progress. When other circumstances are equal, the fertile country is as likely to take the lead of a barren one in navigation, as in other departments of industry. Its soil supplies a larger stock of exchangeable commodities, and its superior density of population, accelerates the acquisition of those various branches of knowledge, on which the adventurous and complicated art of navigation depends.

The Phœnicians are understood to have surpassed all their neighbours in the eastern part of the Mediterranean in extent of commerce. Their reputation rests on a concurrence of traditional and historical authority, and the power of their capital Tyre, was ascertained beyond a doubt, by the length of her resistance to the overwhelming forces of Alexander. Superior, however, as the Phœnicians were to their immediate neighbours, they were probably inferior as navigators to the Athenians, and evidently much behind their reputed descendants the Carthaginians.

Commerce of the Carthaginians.

Our ignorance of the early condition of the latter, is one of the principal desiderata of ancient history. Their power appears to have increased with all the rapidity attendant on confirmed habits of national industry. Notwithstanding a very defective government, and a comparative unacquaintance with land tactics, they long repressed the rising greatness of Rome; and the eventual triumph of the latter may be ascribed, according to the judicious remark of a late writer,* to that fortunate constitution, which gave every citizen an interest in the prosperity of the republic. The navigation of the Carthaginians embraced the north of Africa, Sicily, Spain, and, more or less, the distant shores of the Mediterranean to the east, and of the ocean to the west. How far the north of France or our own coasts came, as has been long asserted, within the range of their exploring labours, we will not pretend to determine.

Commerce of the Greeks.

In Greece, the chief commercial cities were Athens and Corinth. Each sent abroad colonies, which rivalled the trade and navigation of the parent state. The Euxine on the one hand, and Sicily on the other, appear to have been almost the farthest limits of Grecian commerce; but an active traffic must, no doubt, have been carried on with the nearer shores of Thrace, Asia Minor, and Italy. The superiority of the Greeks over the Persians in actions by sea as well as by land, rests on undoubted testimony; but the cause of this, if analyzed, will be found to have lain more in courage than in dexterity. The Greeks generally fought in small vessels without decks, and rushed forward with impetuous valour to board the ships of their enemies. (*Thucydides*, l. 1. c. 14.) So little were they advanced in navigation, that, at the time of the expedition of Xerxes, the distance between Ægina and Samos was made an objection to their attempting the voyage. (*Herodotus*, lib. 8. cap. 132.) Their knowledge of the rest of the globe was founded on conjecture, or derived from the verbal reports of the few persons, who had been induced, by love of science, or by commercial pursuits, to extend their travels into Asia Minor, and into Egypt. The obstinate defence of Tyre seems to have given Alexander a powerful impression of the vast wealth derived from commerce, especially from that with the East Indies. He was accordingly induced, after conquering Egypt, to lay the foundation of a city, which was to be the centre of trade as well as the seat of dominion. The situation of Alexandria was so well chosen, that it continued a great commercial sea-port for many ages, and did not fall into absolute decay until the loss of the India trade, by the discovery of the passage by the Cape of Good Hope.

Commerce of the Romans.

The progress of the Romans in navigation and discovery was still less considerable than that of the Greeks. Their military education, and the spirit of their laws, concurred to estrange them from commerce and naval affairs. It was the necessity of opposing a formidable rival, not the desire of extending trade, that first prompted them to aim at maritime power. Its advantages soon became apparent, though, after they had rendered themselves masters of the sea, they still considered the naval service in a subordinate light, and never imbibed the commercial spirit of the conquered nations. Trade and navigation were abandoned, like the mechanical arts, to slaves, to freedmen, to provincials, and to citizens of the lowest class. Yet the spirit of the Roman government, and the consolidation of rival states into one empire, had the effect of giving great additional security to commerce. By sailing to the Indian continent from the Red Sea, navigators became acquainted with the periodical course of the winds. (*Plin. Hist. Nat.* lib. 6, c. 23.) The uniform direction of the breeze supplying the place of the compass, and rendering the guidance of the stars less necessary, they reached the western shore of the Indian continent with safety, and with equal facility returned with the eastern monsoon. The discovery of this new method of sailing to India, was the most considerable improvement in navigation made during the continuance of the Roman power; for, in ancient times, the knowledge of foreign countries was acquired much more by land than by sea.

The transfer, in the fourth century, of the seat of empire to Constantinople, could not fail to affect the wealth and grandeur of Rome. The subsequent invasion of barbarous hordes tended farther to divest mercantile intercourse of the requisite security; and in the

* Mr Brodie, author of the *History of the Roman Government.*

Commerce. course of ages, Constantinople appeared to be almost the only place where commerce flourished, and the literary treasures of antiquity were to be found. No situation could be better adapted to the maintenance of communication with surrounding countries. On the one hand lay the Euxine; on the other, the Mediterranean. When Egypt was separated from the empire by the Arabians, and the intercourse with India was suspended, a new channel was found out for the transport of eastern commodities. They were carried up the Indus, as far as that great river is navigable, and were then transported by land to the banks of the Oxus. Here they were again put on ship-board, and conveyed down the stream to the Caspian, where they served to load vessels belonging to the merchants of Constantinople. *Ramusio*, vol. 1. p. 372.

Progress of commerce in Italy.

In modern times, Italy became, from the concurrence of different causes, the chief scene of the revival of commerce. Venice was founded in the midst of waters, by fugitives, who sought safety in flight from the ravages of the Huns. In progress of time, this little republic became the seat of wealth and of considerable political power. The possession of the trade to India, by way of Egypt, has been accounted by many the main spring of that grandeur, of which the origin should be sought in a more comprehensive cause. Genoa and Pisa followed in the same career of industry and prosperity; but their progress was eventually retarded by wars abroad, and by civil dissensions at home. Constantinople, being still the only great city in that age, became the principal mart of the Italians. There they obtained great mercantile privileges, and were supplied both with the precious commodities of the East, and those which the ingenuity that still subsisted among the Greeks enabled them to manufacture, and vend to their neighbours. The sagacity of the Italians discovered also other methods of procuring rare and precious commodities, as they were enabled to purchase them occasionally in Aleppo, Tripoli, and other parts of Syria, to which they were brought by a route not unknown to the ancients. They were conveyed from India by sea up the Persian Gulf, and, ascending the Euphrates and Tigris as far as Bagdad, were carried by land across the desert to Palmyra, and from thence to the towns on the Mediterranean. It was while Italy was thus advancing in the career of improvement, that the martial spirit of the Europeans, inflamed by religious zeal, prompted them to attempt to deliver the Holy Land from the dominion of the Infidels. A new sphere for Italian industry was here created. The Genoese, the Pisans, and Venetians, supplied the crusaders with military stores, provisions, and shipping; receiving in return large sums of money, as well as great commercial privileges in Palestine and the maritime parts of Europe. The sight of the comparatively civilized countries of the Mediterranean, afforded considerable means of improvement to the rude inhabitants of the north. Among other things, it deserves to be mentioned, that they here found, in the laws of Rhodes, the first outline of marine insurance. (Schomberg's *Observations on the Rhodian Laws.*) By a fortunate coincidence, the discovery of the mariner's compass took place soon after. This discovery, which has been truly said to have "opened to man the dominion of the sea," was made by a citizen of Amalfi in Italy, about the year 1302. It was in vain that the commercial jealousy of the Italians laboured to conceal it from other nations. Its properties were of too general use to be kept secret.

Our countrymen appear to have been considerable gainers, as well as their neighbours, by the intercourse with the civilized part of Europe attendant on the crusades. Our enterprising monarch, Richard I. is supposed to have directed the compilation of the celebrated laws of Oleron (Selden *de Dominio Maris*, c. 24.) from the Rhodian maritime code. However, the progress of English commerce was not in correspondence with so auspicious a beginning; for in the reign of Edward III. more than a century afterwards, navigation (Hume's *History of England*, 8vo. edit. vol. ii. p. 494.) and industry were at a low ebb. That monarch, struck with the flourishing state of Flanders, and perceiving the true cause of its prosperity, endeavoured to excite a similar spirit among his subjects, who seemed blind to the advantages of their situation, and unacquainted with the sources, whence they (Robertson's *View of Society*, &c.) might derive wealth and opulence. So far were they lulled by ignorance and indolence, that they did not even attempt those manufactures, the materials of which they themselves supplied to foreigners. But notwithstanding the endeavours of Edward, and the many wise establishments proposed and encouraged by him, (Park's *Introd.* 36. 5th edit.) it was not till the reign of Elizabeth, that the English began to discover their true interests, and the arts by which they were to obtain the pre-eminence which they now hold among commercial nations. This slow progress may be accounted for on various grounds. During the Saxon heptarchy, England was split into many kingdoms, perpetually at variance with each other. It was exposed to the incursions of the northern pirates, sunk in barbarity and ignorance, and consequently in no condition to cultivate commerce, or pursue any system of wise and useful policy. To this succeeded the Norman conquest, and all the consequences of a feudal government, military in its nature, hostile to commerce, to the arts, and to the refinement of a liberal and civilized people. Scarcely had the nation recovered from the shock occasioned by this revolution, when it was engaged in supporting the pretensions of its monarchs to the French crown; and it long continued to waste its vigour and wealth in wild endeavours to conquer that country. To this we may add the destructive civil wars between the houses of York and Lancaster, which deluged the kingdom with blood, and to which a period was at last happily put by the union of their several titles to the crown, in the person of Henry VII. The reformation became the next source of agitation, and it was not till the reign of Elizabeth, that the feuds and dissensions, which such an important event necessarily occasioned, began to subside. During her long reign, and her wise administration, commerce began to rear its head, and found at last effectual protection from the directors of public affairs.

Progress of commerce in England.

Hanseatic league.

On turning from our own country to the continent of Europe, our attention is chiefly occupied by the celebrated Hanseatic league. This league took its origin from the necessity of a permanent confederation on the part of the different cities, for the purpose of protecting their navigation. Europe in that age was occupied by men "whose trade was war," and who accounted it no great crime to lay violent hands on the property of a foreign merchant. In the year 1200, this association had branched out so as to comprehend no less than seventy-two cities, consisting of sea-ports of the Baltic, Holland, France, Spain, Portugal, England, and a few of the Italian ports. Such was the progress of a union, confined on its first formation to the towns of Lubeck, Bremen, and Amsterdam. The league lasted in power and splendour to the sixteenth century, a period during

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which it had occasion, more than once, to resort to arms, and punish the rapacious disposition of the kings of Denmark. At last the improved government of Europe, lessening the necessity of this confederation, the different branches of the league gradually fell off, and remained satisfied with the protection of their respective sovereigns.

In the fourteenth century, the woollen manufacture was so little understood in this country, that Edward III. wrote a letter with his own hand, to John Kemp, a woollen manufacturer in Flanders, offering to take him, and his servants, apprentices, goods, and chattels, under his royal protection, (Rymer's *Fœdera*, p. 496.) and promising the same to all others of his occupation, as well as to all dyers and fullers, who should incline to come and settle in England. (A. D. 1337.) No less than seventy Walloon families, engaged in the woollen manufacture, availed themselves of this encouraging offer, and came over to settle here. Only four years after the introduction of the first woollen manufacturers from Flanders, an act of parliament (the 11th of Edw. III. c. 2.) was passed, to prevent the exportation of wool, and holding forth protection and rewards to all cloth-workers who should come from foreign parts. By another act, (the 11th of Edw. III. c. 1.) all persons other than the king, queen, and royal family, were prohibited from wearing any cloth that was not manufactured within the realm. The importation of foreign cloth was also forbidden on pain of forfeiture and other punishment. But so jealous were the weavers of our own coarse cloths, of the introduction of better workmen from abroad, that, in 1344, a mob in London, principally composed of, and instigated by them, insulted and maltreated the foreign weavers, so that they could not carry on their business with security. Upon this warrants were issued by the king, directed to the mayor and sheriffs, to imprison the ringleaders in the jail of Newgate.

Such was the comparative insignificance of our exports, even so late as 1534, that the whole, from every part of England, did not exceed L.900,000, of the present value of our money. Yet the balance of trade in our favour at that period, was imagined to exceed L.700,000, as appears by a record in the exchequer. This balance, arising principally from the exportation of wool and woolfels, lead, tin, and leather, appeared very great in proportion to the whole amount of the trade, and produced a duty of customs on export to the amount of L.246,000, according to the present value of money, while the duty on imports amounted to little more than L.1700.* It is curious to observe by what slow degrees the commercial improvements, at present most familiar to us, were introduced among our ancestors. The practice of making remittances by bills of exchange, was so little known or followed in England in the 15th century, that Henry IV. granted leave to Philip d'Albertis, a rich Lombard merchant then residing in London, to give a bill of exchange (*literam cambii*) on his partners abroad for 2500 merks sterling to the Bishop of Bath and Wells, or his attornies, on the express condition, that "neither the said gold received for the bill of exchange, nor any other gold or silver, either in coin or bullion, be transported beyond sea under colour of that licence, upon pain of forfeiting all the money so transported."

Elizabeth fortunately possessed in Cecil a minister capable of giving unwearied attention to political subjects, and much more disposed to seek the establishment of public wealth in internal regulation than in schemes of foreign conquest. One of the earliest applications of his talents related to the copartnership of German factors of the Steel-yard, who, by a mistaken policy, enjoyed particular privileges and immunities in exporting our cloths. These factors traded principally to Antwerp and Hamburgh, and found means, partly by superior capital, partly by the enjoyment of preferences from government, to render all competition unavailing. A particular investigation being made by Cecil, it appeared that while the whole body of English merchants had exported in the preceding year only eleven hundred cloths, the German merchants of the Steel-yard had exported forty-four thousand. Their immunities were therefore abolished; and such were the effects of this decisive step, that the very next year the English merchants exported forty thousand cloths to Flanders. Of the favourable effects of this and other wise measures of Elizabeth's cabinet, we shall be fully satisfied by adverting to the circumstance of the customs having been farmed at the commencement of her reign by Sir Thomas Smith, at fourteen thousand pounds a-year, while towards its close, he paid fifty thousand pounds for them. The laws and regulations of this reign infused a spirit of enterprise into the nation, which produced wonderful effects. The passage to Archangel was discovered, and a trade opened with Russia, a region till then scarcely known in this kingdom. The Czar, John Bazilowitz, granted extraordinary privileges to the English throughout his dominions; and an attempt was made to open a trade with India by the rivers Dwina, Wolga, and the Caspian Sea, which, although tedious and expensive, would have had its advantages, had not our navigators preferred following the route of the Portuguese round the Cape of Good Hope.

The rich prizes captured by Sir Walter Raleigh near the Azores in 1593, tended farther to excite the national impatience for a direct trade with India. Accordingly, in the year 1600, a foundation was laid for this celebrated company, by associating a body of merchants, whose capital, divided into shares of £50 each, amounted in all to no more than £72,000. Their shipping likewise formed a curious contrast to its subsequent extent, being confined to five vessels, measuring only 1330 tons in all, and valued collectively at £27,000.

The judicious system pursued by Elizabeth for the advancement of trade, was considerably favoured by

* From the 11th of Edward III. to the 43d of Elizabeth, the following acts passed for improving and regulating the woollen manufactures of England, admeasurement of cloths, &c. viz.

11 Edw. III. c. 3. 5.	13 Hen. IV. c. 4.	3 Hen. VII. c. 11.	3 and 4 Edw. VI. c. 2.
18 —— c. 3.	2 Hen. VI. c. 5.	4 —— c. 8. 11.	5 and 6 —— c. 6. 8.
31 —— c. 8.	8 —— c. 22.	3 Hen. VIII. c. 6. 7.	4 and 5 P. & M. c. 5.
38 —— c. 6.	14 —— c. 2.	6 —— c. 9.	8 Eliz. c. 6.
50 —— c. 7.	18 —— c. 15. 16.	22 —— c. 1.	14 —— c. 10.
3 Rich. II. c. 2.	3 Edw. IV. c. 1.	24 —— c. 2.	23 —— c. 9.
14 —— c. 4.	4 —— c. 1.	27 —— c. 12. 13.	39 —— c. 11. 14. 20.
4 Hen. IV. c. 6. 24.	7 —— c. 3.	37 —— c. 15.	43 —— c. 10.
7 —— c. 10.			

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the emigrations of Protestant Flemings, who fled from the tyranny of the Duke of Alva. Flanders had by that time made great progress in commerce and manufactures. Bruges, Ghent, and Antwerp, were cities superior to any in Europe, except the commercial capitals. The inhabitants were formed to the practice of regular industry, and brought over to England habits and knowledge of the most useful kind. This conduct on the part of the Spaniards was very similar, both in its motive and in its consequences, to the recal, a century afterwards, of the edict of Nantes by Louis XIV.

Origin of the navigation laws.

However questionable may be the merits of our navigation laws, with reference to our progress in commerce, it may be proper, in this article, to say a few words about their origin. It is generally assigned to the time of the commonwealth and Charles II.; but it goes, in fact, much farther back than either Cromwell or Charles, (12 Car. II. c. 18, 27 Geo. III. c. 19, 37 Geo. III. c. 63,) the first provision of this nature having been made in the latter part of the reign of Edward III. (42 Ed. III. c. 8, 7 & 8 Will. III. c. 22, 34 Geo. III. c. 42, 68.) The next law of importance on this subject, was framed in the reign of Henry VIII.; (23 Hen. VIII. c. 7, 26 Geo. III. c. 60, 35 Geo. III. c. 58.) but a law of Elizabeth's reign in 1563, entitled, "An act touching politic constitutions for the maintenance of the navy, &c." (5 Eliz. c. 5,) may be considered as in a manner the outline of the system. By this law, herrings and other fish caught on our coasts, are permitted to be exported duty free; no foreign ships are to be allowed to carry goods coastwise, from one port to another; and wines and wood were permitted to be imported from France in English ships only.

History of Dutch commerce.

Of the commercial countries on the continent of Europe, the most interesting, whether we look at its long struggle for independence, its indefatigable perseverance, or its splendid acquisition of wealth and power, is Holland. The observations of Sir William Temple, afford striking illustrations of the national character, as well as of the condition of trade, at a time when it was in full vigour. Without entering into a lengthened exposition of the history of Dutch commerce, we shall take notice of two points not generally admitted into the notions formed of this remarkable people. First, that their commerce was not of such sudden growth as is commonly imagined, Amsterdam having been a large and populous city before the revolt from the Spanish yoke; and secondly, that until the present age of unexampled distress, the navigation and wealth of the Dutch had not undergone that great decrease which many writers have put upon record. Their fall had been more relative than absolute; the other maritime states of Europe, particularly England, having advanced during the last century with great rapidity. The Dutch continued industrious, economical, and even enterprising; but their own territory being small, and of little fertility, a great proportion of their capital was lent out on foreign securities. Not only were the treasuries of princes replenished by loans from Holland, but a variety of private undertakings, such for example as iron mines in Sweden, were worked by Dutch capital. Their wealth was thus made instrumental in augmenting the prosperity of other countries, and afforded a memorable indication of the laws by which the indefinite acquisition of property is restrained. Besides, the debts of other countries to Holland being payable not in real property but in money, underwent that progressive and eventually great depreciation, which has marked the history of the circulating medium throughout Europe. We now return to the affairs of our own country, and proceed to examine the present state of British commerce.

Present state of British commerce.

II. *Present State of British Commerce.*—On looking back to the æra of the Restoration, we find, that the whole quantity of merchant shipping employed in our coasting and foreign trade did not exceed 140,000 tons. Of these, the third part was foreign, and particularly Dutch, which led Sir William Temple to remark, that, notwithstanding our discouraging foreign vessels in our ports, the trade between England and the Continent was principally conducted by Dutch vessels. In spite of the bad government of Charles II. the enjoyment peace during the chief part of his reign, produced great increase in our mercantile shipping, so that, at the Revolution, it was found to have doubled in the course of the preceding twenty-five years. The long wars under William and Anne operated to retard its augmentation; but the peace of Utrecht gave fresh vigour to our trade, and enabled us to dispense with those neutrals to whom we had had recourse in the season of hostility. However, the increase of our trade during the first half of last century was very gradual. In the long period of almost uninterrupted peace between 1713 and 1739, our tonnage did not increase above one-seventh, viz. from 421,000 to 476,000 tons. The value of our exports was less stationary, and rose somewhat more than a fourth, viz. from £7,300,000 to £10,000,000. In the interval of peace between 1748 and 1755, a considerable improvement took place. The recommencement of war damped it to a certain degree; but on the whole, the increase during the latter half of last century was very great, as we perceive from the subjoined Table.

	The first year of Geo. III.	Tonnage of Merchant Vessels cleared outwards. English.	Tonnage of Merchant Vessels cleared outwards. Foreign.	Value of our Exports.	Nett amount of our Customs.
War.	1760	540.241	107,237	15 781 175	1,969.934
	1761	582.020	122,735	16,038.913	1,866.152
	1762	543,444	124,926	14,543,336	1,858,417
Peace.	1763	631,724	91,593	15,578,943	2,249.604
	1764	662,434	79,800	17,446.306	2,169,473
	1765	726.402	72,215	15,731,374	2,261,231
	1766	758.081	66,153	15,188,668	2.448,280
	1767	725,835	68,006	15,090.001	2,355.850
	1768	761,786	77,984	16.620,133	2,445 016
	1769	805,305	68,420	15.001,280	2,639,086
	1770	806,495	63,176	15,994,571	2,546,144
	1771	877,004	66.898	19,018.481	2,642,129
	1772	923.456	72.931	17,720,169	2,525,596
	1773	874,421	57.994	16,375,431	2,439.017
	1774	901,016	68,402	17,288.487	2,567,770
War.	1775	882,579	68.034	16,326,364	2,481.031
	1776	872,108	74,323	14.755.699	2,480.403
	1777	827,067	102,638	13 491.030	2.229.106
	1778	732,558	93,778	12,253.895	2,162,681
	1779	642,981	149,040	13.189,325	2,502.274
	1780	731,286	154,111	12.648,616	2.723,920
	1781	608,219	170.775	11 342.296	2,791,428
	1782	615.150	225,456	13,017,391	2,861.563
	1783	865,967	170,938	15.468.287	2.848.320
Peace.	1784	932.219	118,268	15,734,062	3.326.639
	1785	1,074,862	107.484	16,117.649	4.592.091
	1786	1,115,024	121.197	16.300,726	4,076.911
	1787	1,279,033	138,220	16,870,144	3,673,807

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	The first year of Geo III.	Tonnage of Merchant Vessels cleared outwards. English.	Foreign.	Value of our Exports.	Nett amount of our Customs.
Peace.	1788	1,411,689	128,997	17,472,408	3,780,770
	1789	1,515,021	103,722	19,159,471	3,710,340
	1790	1,424,912	148,919	20,120,121	3,782,822
	1791	1,511,246	184,729	22,731,995	3,952,507
	1792	1,561,158	175,405	24,905,200	4,027,230
War.	1793	1,240,202	187,032	20,390,180	3,978,645
	1794	1,382,166	218,077	26,748,083	3,565,117
	1795	1,145,450	382,567	27,123,339	3,569,360
	1796	1,254,624	478,356	30,518 913	3,661,757
	1797	1,103,781	396,271	28,917,010	4,111,105
	1798	1,319,151	365,719	33,591,777	5 599 087
	1799	1,302,551	414,774	33,640,357	7,538,855
War.	1800	1,445 271	685,051	38,120,120	6,799,755
War.	1801	1,345,621	804,88[illegible]	37,786,857	5,895,711
Peace.	1802	1,626,966	461,723	41,411,966	6,087 569
War.	1803	1,453,066	574,542	31,438 495	7,179,621
	1804	1,463,286	587,849	34 451,367	8,357 871
	1805	1,495,209	605,821	34,954,845	9,084 459
	1806	1,486,302	568,170	36,527 185	9 733,814
	1807	1,424,103	631,910	34,566,571	9,207,735
	1808	1,372,810	282,145	34,554 268	8,797 823
	1809	1,531,152	699,750	50,301,763	10,289,807
	1810	1,624,120	1,138,527		
	1811	1,507,353	696,232		

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Having thus seen the history of the progressive augmentation of our exports, we are next to observe the proportions in which they are distributed to different countries.

Custom-house Return of the Official Value of the Exports from Great Britain to the Continent of Europe, to the West Indies, to America, to Africa, and to Asia, respectively, from 1805 *to* 1809, *inclusive.*

	1805.	1806.	1807.	1808.	1809.
Continent of Europe . .	£15,465,430	£13,216,386	£12,689,590	£11 280,490	£23,722,615
West India Islands . . .	4,096,196	5,339,612	5,433,267	7,507,575	8 755 193
Continent of America . .	8,067,671	10,754,140	9,455 028	8 369,472	10,570,100
Africa	990,625	1,433,153	797,741	532,842	703,180
Asia	1,669 214	1,936,954	1,884,438	1,933,225	1,647,927

In both Tables, the value inserted is not the real, but the official value; that is, a valuation of merchandise at a given sum per bale, trunk, cask, or other package, according to a scale laid down for the regulation of the custom-house officers above a century ago. Since the imposition of convoy duty, which is a tax *ad valorem*, the commissioners of the customs are in possession, by the declarations of the merchants, of the real value of exported goods, and find it in general about 60 per cent. above the official computation. Still the old form is retained, and is useful as exhibiting a correct statement of the progressive increase, *in quantity*, of our exported merchandise. The following extract, from a custom-house report, exhibits a contrast between the two modes of valuation, in the case of an important branch of our commerce.

Official and Real Value of the Exports from Great Britain to the Continent of Europe, from 1805 *to* 1809, *inclusive.*

	Official Value.	Real Value.
1805	£15,465,430	£20,435 940
1806	13 216 386	17,547,243
1807	12 689,590	15,420,514
1808	11,280 490	13 983,123
1809	23,722,615	27,190,337

Official and Real Value of the Imports into Great Britain from the Continent of Europe, from 1805 *to* 1809, *inclusive.*

	Official Value.	Real Value.
1805	£10,008,649	£21,744,762
1806	8,197,256	17,855,524
1807	7,973,510	17,442,755
1808	4,210,671	8,905,099
1809	9,551,857	19,821,601

The discrepancy between the two modes of valuing, is evidently much smaller in the case of continental exports than imports; a discrepancy which is chiefly to be attributed to inequalities in the alteration of the value of particular articles since the formation of the Customhouse Table. It is more particularly owing to the circumstance, that coffee, which is now very frequently exported at L. 5 per hundred weight, is valued in the Table in question so high as L. 14, the culture of that plant being at that time very little understood.

Balance of trade.

We are next to direct our attention to the question of the balance of trade;—a point on which, until lately, our merchants and ministers were accustomed to lay great stress. It is still a current notion, that the profit attendant on foreign trade is realized in the shape of a clear balance of payments made to us by the rest of the world. The customhouse books have been re-

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Official Value of our Imports and Exports with the Continent of Europe, from 1805 *to* 1809 *inclusive.*

Years.	Imports.	Exports.	Balance in favour of Great Britain, reckoned in Official value.
1805	L.10,008,649	L.15,465,430	L.5,456,781
1806	8,197,256	13,216,386	5,019,130
1807	7,973,510	12,689,590	4,766,080
1808	4,210,671	11,280,490	7,069,819
1809	9,551,857	23,722,615	14,170,758

In this, however, are omitted some very important items, such, for example, as draughts and remittances of bills of exchange, the sum of which is frequently so very great, as to give almost a new aspect to the account. Moreover, the abstract takes no notice of the export or import of bullion; of the monies paid to foreigners for freight; nor of the value of smuggled goods. The following calculation is made out on a comprehensive plan, and exhibits an allowance for several of those considerations, which, from the nature of the customhouse books, cannot be entered in a regular shape in an official return.

Customhouse Return of the Balance of Trade in favour of or against Great Britain, in her Commerce with all Parts of the World, from 1805 *to* 1809, *inclusive.*

	1805.	1806.	1807.	1808.	1809.
Real value of imports as sold to the consumers, including mercantile profit to the importers, but exclusive of duties; also including the freights, great part of which are paid to British subjects	*L.* 53,582,146	*L.* 50,621,707	*L.* 53,500,990	*L.* 45,718,698	*L.* 59,851,352
From which is deducted,					
1. The value of the Newfoundland, Greenland, and Southern whale fisheries . . . . 2. The surplus of imports from British colonies and plantations, considered as favourable balance . . 3. The surplus of imports from British India, likewise considered as favourable balance	9,089,449	8,026,553	8,885,275	8,230,242	8,718,289
Real value of imports (exclusive of the above-mentioned deductions)	44,492,697	42,595,154	44,615,715	37,488,456	51,133,063
Real value of exports (exclusive of the freights outwards)	51,109,131	53,028,881	50,482,661	49,969,746	66,017,712
Balance in favour of Great Britain .	*L.* 6,616,434	*L.* 10,433,727	*L.* 5,866,946	*L.* 12,481,290	*L.* 14,884,649
	Medium of 1805 and 1806, *L.* 8,525,080.			Medium of 1806 and 1807, *L.* 9,174,118.	

Notwithstanding the attention with which this estimate was prepared by Mr Irving, inspector-general of the customs, it is necessarily defective in the points mentioned above. Whenever there exists an extraordinary difference, as in the case of our exports and imports with the continent of Europe, we have reason to suspect the existence of some latent drain; and when the great expence of our foreign garrisons and occasional subsidies is taken into account, we need be at no loss to explain the cause of the above mentioned inequality. It is singular enough, that every nation makes the balance of trade in its own favour. But the true way of estimating the difference of value between the same goods in different places, is to attend to their approximation to a market of consumption. A hogshead of sugar, for example, is of more value in Britain than

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in Jamaica;—a ton of copper of more value in Holland than in Cornwall. By making due allowances in this respect, we shall be enabled to account for the apparent contradictions of customhouse returns, without the ridiculous supposition of a loss on one part, whenever there exists a gain on another.

Trade of Ireland.

We conclude our mercantile Tables by a statement of the trade of Ireland.

Value of all Imports into, and all Exports from Ireland, for five Years, ending the 5th January 1810*; distinguishing each Year, and the Value of Irish Produce and Manufactures from the Value of Foreign Articles exported; together with the Difference between the Official Value and the declared Value of Irish Produce and Manufactures exported in the Years ending 5th January* 1808, 1809, *and* 1810.

		Official Value of Imports.	Official Value of	
			Irish Products and Manufactures Exported.	Foreign and Colonial Merchandise Exported.
		£	£	£
Year ending 5th Jan.	1086	5,736,214	5,059,867	142,481
	1807	5,605,964	5,030,722	157,443
	1808	6,637,907	5,307,806	150,370
	1809	7,129,507	5,696,897	235,694
	1810	7,471,417	5,408,910	330,933

Note.—The real value of Irish produce and manufactures, computed at the average prices current, exported in the years ending 5th January 1808, 1809, and 1810.

Year ending 5th January	1808 . . .	£10,110,385
	1809 . . .	12,577,517
	1810 . . .	11,464,265

Principles of commerce.

III. *Principles of Commerce.*—This department of the subject will be treated at some length under the head of Political Economy. At present we confine ourselves to a few general observations, with the view rather of correcting prevalent errors, than of attempting to give any thing like a system in the case of a subject which requires so great a variety of combinations.

Our readers have seen, from the Tables above, the rapid increase in the value of our exports and customhouse duties. A similar increase has taken place, as is well known, in the value of landed property and of houses, in the general revenue of the country, &c. Although more striking, and perhaps more rapid in the present than in any former age, a progress of this nature has been regularly taking place during the last three centuries. Dr Davenant computed, that between the years 1600 and 1688, the "rental of England was nearly tripled, the money in circulation quadrupled, and the capital of the country increased fivefold."—Such augmentations are commonly, we may say almost universally, considered in the light of proportional additions to the stock of public wealth. Our ministers are accustomed to expatiate in parliament on the rapid increase of national property, as demonstrated by the increased produce of our taxes; and persons in private life, though conscious that their individual circumstances are not improving, take for granted, from the general enhancement of commodities, that there must be a large accumulation of property throughout the country. It seldom occurs to these persons, that the *fall in the value of money* would afford, in a great degree, a solution of the contradiction between their own straitened circumstances and the appearance of general prosperity. On turning to the official tables of custom duties, we find an increase of double the amount between 1792 and 1808. Part of this increase arises from additional imports; part from extension of trade. But in neither case must we flatter ourselves, that government have doubled the *real* amount of the customs, since, from the fall in money in the course of these sixteen years, eight millions in 1808, would go no farther than five or six millions in 1792. On applying a similar rule to the computation of private property, we find estates yielding now a rental of fifteen thousand pounds a-year, which, twenty years ago, did not yield nine thousand. Part of this difference is the result of the improvement of the land, but another part, by much the larger, arises from the fall of money. The proprietor, on comparing the relative prices of the necessaries and comforts of life, will find that the larger sum does not at present go much farther than the smaller did in 1793. It is not enough to contend, in opposition to this, that the rise in price has not been equal in all articles; for, in a general view of those things which constitute domestic expenditure, and for which, of course, money is chiefly required, the computation will not prove exaggerated. The great exception is found in the case of manufactures. Here the improvements, from the use of machinery and the division of labour, have been so extensive and so rapid, as to outweigh both the increase of wages and the enhancement of the raw commodity.

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This explanation of our supposed increase of wealth is by no means flattering to those whose minds have been elated with the belief of a rapid augmentation of our power and riches. They will find, however, a kind of counterpoise to their disappointment in the exposition which we are now going to make of another popular error. It was a saying of the respected Judge Hale, that "the more populous we are, the poorer we are;" and a writer of the present day has circulated a long list of gloomy anticipations, from an apprehension of excess in population. Now the fact is, that in every tranquil and well-governed country, the ratio of increase in population may, in various respects, be regarded as an index of the advancement of its political power. We view it in this light, less as a supply for armies and navies, than as a means of augmenting the productive powers of national capital. How wide a field is still open for agricultural improvement, will be apparent on considering, that the counties which have been rendered the most productive in our island, we mean the north of England, and the south-east of Scotland, are by no means the quarters most favoured in point of soil and climate. Were the practice of granting leases general in the south and west of England, the farmers would progressively acquire the enlightened habits of their northern countrymen, and would learn, like them, to lay out capital on land with a liberal hand, in the same way that a trader lays it out in merchandise. It is superfluous to add, how greatly the produce of the earth, or, in other words, the means of supporting a growing population, would be augmented by the adoption of this simple course. Much more, we believe, would be gained by improving the management of land already cultivated, than by attempting, at a large expence, to render commons and waste lands productive. Both, however, are pleasant objects in prospect, and are of a nature to tranquillize us in regard to apprehensions of deficient provision. By the official returns of population, we have seen an increase, between 1801 and 1811, of nearly a million and a half in Great Britain; an increase owing to the introduction of vaccination, and to causes more likely to operate in peace than in war. Peace, however, in accelerating the progress of our numbers, will restore to us the labour of a portion of our countrymen, who are well calculated to extend the produce of the earth. Ireland likewise, largely as she has of late contributed to our corn supplies, is still far from being cultivated to the point of which her fertile soil is capable.

The topic which we take up, in the *third* place, is the supposed superiority of our foreign to our inland trade. It is a very common notion, that money can be made by a country by foreign trade only, while all inland transactions are mere transfers from hand to hand. If we examine the speeches of our statesmen, we find the amount of our exports perpetually adduced as the grand criterion of national wealth; and, if we look to a less friendly quarter, the cabinet of Bonaparte, we see decree follow decree on the presumption that the exclusion of British commerce from the continent would prove the grand instrument of our downfall. Nay one writer, of official eminence at Paris, M. de Montgaillard, goes the length of asserting, that "India is the grand source of the wealth of Britain; Calcutta, not London, her real capital." Notwithstanding these high-sounding authorities, we may, we believe, assert without exaggeration, that the produce of our foreign trade is not more than *one eighth*, perhaps not *one tenth* of that of the inland. We take, of course, the word trade in its most comprehensive meaning, viz. as expressive of "all industry directed to a productive purpose." We understand by it, the exertions of all those who, whether agriculturists, manufacturers, mechanics, shopkeepers, &c. labour for the progressive augmentation of their individual property. It is by thus labouring for themselves that they contribute to the extension of national wealth. The distinctions so frequently made between those who, by their business, bring money into a country, and those who are supported by professions which apparently form a charge on their neighbours, will often prove to have little foundation. The exact limit between productive and unproductive industry has not been successfully defined by our ablest political economists; but all who have gone thoroughly into the science are satisfied, that the productive character belongs as strongly to home as to foreign transactions. The practical result of this most important truth is, that the relative value of foreign commerce has hitherto been much overrated. We have gone to war with Holland and with France for particular branches of trade, and have expended, in a single twelvemonth, more of the national treasure, than would be repaid by the possession of the traffic in question for one hundred years. Another conclusion of a more consolatory nature regards the solidity of the basis on which our national power rests. France, in excluding us from the Continent, could not, with all her efforts, suspend above one twentieth part of our productive industry; a proportion by no means insignificant, but infinitely below that which both we and our enemies were led to anticipate. Accordingly, it was not until the additional loss of our North American trade in 1808, or more properly in 1811, that a serious blow was given to our commercial prosperity.

The *fourth* and *last* point to which we shall at present advert, regards an idea which is still very prevalent among people at large, although excluded from the creed of enlightened inquirers. We have in view the notion, that, in trade, one nation loses as another gains; and that rivalship in commerce is founded on serious and substantial reasons. How often has it been predicted, that the French, by the cheapness of labour, by the attention of their government, at particular intervals, to the promotion of commerce, or, by the acquisition of certain settlements, such as Louisiana or St Domingo, were about to give a death blow to correspondent branches of British manufacture and commerce. Yet ages, we may almost say centuries, have passed away, without the realization of these gloomy predictions. In regard to government interferences, we may, once for all, dismiss apprehension from our thoughts, by the conviction, that, whenever a government diverts the current of industry from its natural channel, it infallibly throws a proportion of it to waste. The only sound policy in a government is to give security to property, and freedom, unrestricted freedom, to the developement of industry. Next, as to the augmentation of public wealth consequent on this judicious course, the nations trading with a flourishing country may be assured, that their gains, from intercourse with her, will not fail to go hand in hand with her prosperity. Portugal has long been reputed the country on the Continent, from which, in proportion to its population, we obtained the largest profits; but, on close inquiry, it will be found, that we realized much more by our trade with Holland. The inhabitants of a rich country have many more wants, and can much better afford to gratify them. The security, in point of payment, is infinitely better,—a point which, though it frequently escapes the attention of a mercantile beginner, or a theoretical calculator, is, in the eye of the experienced trader, a matter of the greatest consequence. It follows, that countries of improved habits, of established capital, and of comparatively little distance, are much more profitable in the way of trade, than the dazzling and remote regions of the east or west. Distance implies a correspondent slowness in the return of capital; a disadvantage which can be compensated only by a larger increase in the rate of profit than is generally allowed for it. Our trade with the United States of America is profitable, but it has become so only of late years, since the condition of our *quondam* colonists has begun to approximate, in point of habits and in state of capital, to the circumstances of the well cultivated parts of Europe.

In regard to Spanish America, the features of our intercourse have been of late traced in very legible colours, and will tend to illustrate the scope of our observations. Until within these five years, the North Americans acted as middle men in our transactions with various parts of the Spanish settlements. Possessing the advantage of vicinity of situation, and of a neutral flag, the inhabitants of the United States were accustomed to re-sell a proportion of the manufactures imported from Britain to their southern neighbours, taking in exchange indigo, cocoa, coffee, sugar, and such other articles as the limited industry of the Spaniards enabled them to export. This intervention of the Americans was viewed with a very jealous eye by many of the ship-owners, of the merchants, and we believe we may add, by some of the ministers of this country. Many

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a calculation was made to shew how much greater would be our profit, were we to send our supplies direct to the Spanish settlements. At last the time came, when this envied traffic was thrown into our hands; the year 1808 having sealed the American ports by the embargo, and opened, in consequence of Bonaparte's usurpation, a free intercourse between Britain and the Spanish colonies. This was followed by a very extensive, or, as it was frequently termed, a *spirited* trade with the western hemisphere; and the amount of our exports was such, as to make a veteran writer on commercial subjects * declare, that, "throughout the effluxion of half a century, the year 1809 was the most prosperous." Unfortunately, however, a great part of this flattering exportation was never paid for. The North Americans had supplied the Spaniards with a cautious hand; but we, conceiving the market inexhaustible, poured in merchandise in immense quantities, and were first taught, by the bankruptcies of 1810, that the Spanish colonists were incapable of giving an equivalent for the goods which we had so liberally sent them. We have now learned, that a country may possess a fine soil, and a delightful climate, without the industry which is necessary to make her inhabitants desirable customers. Without attempting to compute the loss sustained in this quarter, or in the cultivation of newly settled colonies, such as Demerara or Trinidad, the general conclusion is, that much capital is sunk and lost in these countries, while, in trading with our European neighbours, the profits, though small, are steady and of quick return. Instead, therefore, of making war for sugar islands, or cotton plantations, the nations of Europe will, it is to be hoped, become in time alive to the importance of the vast profits which they may make, by trading with each other. In this country, we have no ground to dread the political power attendant on the successful prosecution of commerce by our neighbours; since our insular situation, and the extensive navigation inseparably connected with it, bid fair to assure to us the preservation of the empire of the sea. The Continent possesses, as we have very recently seen, the means of asserting its own independence; and if we analyse the sources of our national losses, we shall frequently find them to have originated more from mistaken measures at home, than from the power of our foreign enemies.

Our limits do not permit us to go farther at present into the general principles of trade; and we conclude, by referring those of our readers, who take an interest in such discussions, to the article POLITICAL ECONOMY. (χ)

COMMERSONIA, a genus of plants of the class Pentandria, and order Pentagynia. See BOTANY, p. 169.

COMMIPHORA, a genus of plants of the class Diœcia, and order Octandria. See BOTANY, p. 337.

COMMODUS. See ROME.

COMMON. See AGRICULTURE.

COMMON CHORD, in Music, is a term applied to the most perfect combination of harmony that is known, and with which pieces of music generally end. In the

III 3 4
major key of C, these notes are C E G c, the inter-
V 6
VIII

vals between each adjacent note being placed above, those of every alternate pair are placed below the letters, and the VIII below these, is the whole interval between the extreme sounds; in which arrangement, it appears that all the seven concords, 3, III, 4, V, 6, VI, and VIII, except the VIth, are heard between the different notes of this chord, the major third being next the bass, to which circumstances are perhaps owing the peculiar effect and delight which this chord affords. If the two thirds be inverted, and the minor third placed next the bass, the chord is then called the common

3 III 4
chord minor, thus C E♭ G c. Here again 6 out of
V VI
VIII

the 7 concords are heard in the sounding of this chord, the minor sixth being now absent, and the minor third being placed next the bass, which circumstances probably occasion, or are closely connected with, the peculiar effect of this minor common chord. It seems rather a singular circumstance, that the VI should be wanting in the major chord, and the 6th wanting in the minor common chord. See our article CHORD. (ϱ)

COMMON LOGARITHMS, in musical calculations. These are often mentioned and used by the musical calculator, and, like all other kind of logarithms, they are *decimal values of a particular interval,* which is their unit, radix, or modulus. This interval is, in the present case, $\frac{1}{10}$th, $= 2033\Sigma + 40f + 176m$; and thus 1, in the *first* place of reciprocal common logarithms, represents $203.3\Sigma + 4f + 17.6m$, or $203.296855\Sigma + 4f + 18m$, being only $.700524\Sigma$ less than the isotonic III, or $\frac{1}{3}$ part of the octave. 1, in the *second* place, represents $20.33\Sigma + .4f + 1.76m$, or $20.395840\Sigma + m$. 1, in the *third* place of these logarithms, represents $2.033\Sigma + .04f + .176m$, or 2.04037022Σ, which differs only $.00020333\Sigma$ from the EXTAMERIDE, or $\frac{1}{301}$ VIII of M. Sauveur. If the recip. log. of the octave be .30103, then from the above $\text{VIII} = 612.000008\Sigma + 12f + 53m$. In like manner, the hyperbolic logarithms are decimals of an interval, whose ratio is $\frac{1}{2.7182818, \&c.} = 882.9718866\Sigma + 17f + 77m$. (ϱ)

COMMON MEASURES *of Musical Intervals.* In our article COMMENSURABLE *Intervals,* we have shewn, that, strictly speaking, there can be no such thing as a common measure or *unit,* by means of which all other intervals might be expressed in whole numbers or in decimals that terminate, or even that circulate or repeat; but that all such numbers expressing intervals (being logarithms of a particular species) will have decimal values indefinitely large, without any law in the continuation of the same being discoverable. Before the important invention of Lord Napier, and the construction of copious tables of logarithms, even the best mathematicians had but imperfect views of the relations and values of the prime ratios to which musical intervals are allied, and hence the many mistakes and inconsistencies in some of the best of the ancient writings on music, (see *Aristoxenian* COMMON MEASURES,) where they treat on the minute relations and values of intervals. Mersennus, for instance, concluded from his calculations, that $58\frac{1}{4}$ major commas made an octave, or $612\Sigma + 12f + 53m$, instead of $638.979614\Sigma + 12f + 55m$, the real value of so many major commas, which error was detected by Nicholas Mercator, who, according to Dr William Holder, (*Treatise,* 1st edit. p. 79,) in an unpublished manuscript, mentions having calculated by logarithms, that there were more than 55 commas ($55\frac{7}{11}$

* Mr George Chalmers. See his *Considerations on Bullion,* p. 1.

Common Measures.

$+ 12f - 2\tfrac{7}{11}m$) in an octave, and that he had "thence deduced an ingenious invention of finding and applying a least *common measure* to all harmonic intervals, not precisely perfect, but very near it."

Of the method or process by which Mercator obtained his series of *artificial commas*, answering to the 19 intervals, which Dr Holder has given as an extract from the manuscript, we are quite uninformed; but to us it seems probable, from the relation, that having calculated the number of commas to the nearest whole number in each case, answering to the 19 intervals mentioned, and found them as follows, (see Plate XXX. Vol. II.) viz. $c=1$, $\mathrm{E}=2$, $\mathcal{S}=3$, $\mathfrak{S}=4$, $\mathrm{S}=5$, $\mathbb{S}=6$, $t=8$, $\mathrm{T}=9$; 3rd$=15$, III$=18$, 4th$=23$, IV$=27$, and 5th$=28$; V$=33$, 6th$=38$, VI$=41$, and 7th$=46$; and VII$=51$, and VIII$=56$; and trying the relations of these by addition and subtraction of these commas, he thus found, that all those from c to T inclusive, exactly answered to the known and corresponding values and relations of these intervals, as found by the multiplication of the terms of their ratios, according to the equations given in our articles Apotome, Comma, &c.; and that again, from the 3rd to the 5th inclusive, the relations of these commas were proper to each other, though each was an unit too much, when compared by the proper additions and subtractions with the first part of the series; and, further, that from the V$^{\text{th}}$ to the 7$^{\text{th}}$ inclusive, the relations were true with respect to each other, but each was 1 comma more than the last part of the series, and 2 commas more than calculations from the first part would have given them; and, lastly, that the VII$^{\text{th}}$ and VIII$^{\text{th}}$ were 3 commas too great for comparison with the first part of the series: and thus probably it was, that the ingenious Mercator was led to reduce all the numbers to the first part, and so deduced his series of *artificial commas*, 1, 2, 3, 4, 5, 6, 8, and 9; 14, 17, 22, 26, and 28; 31, 36, 39, and 44; 48 and 53; answering to the 19 intervals above mentioned, as Dr Holder has given them.

We are not aware, that this mode of accounting for Mercator's unexpected discovery of the curious properties of the above series, was ever before published, or that the same attracted the notice of any curious person in these inquiries after Dr Holder, until the year 1807, when Mr John Farey sen. having extracted all the intervals contained in the Overend, and other manuscripts which he had perused, and, for the convenience of future reference, had, with considerable labour, reduced them all into *one notation*, by the intervals marked Σ, f, and m, as shewn in part in Plate V. in vol. xxviii. of the *Philosophical Magazine*, and in our 30th Plate in Vol. II. He then quickly discovered, that the number of m's in the last column of his Table, answered exactly to Mercator's number affixed to the same interval in Dr Holder's Treatise; and not only shewed the reason thereof, but his table of intervals, so arranged, furnished a far more accurate and extensive set of *artificial commas*, or under commas 612, to the octave, by extracting the number of Σ's in the first column.

It has also been shewn by that gentleman, that each of the columns of any notation of small terms, or intervals, so that negative signs are avoided, except when they affect a whole column, furnishes a set of artificial commas, as must, indeed, be evident, since there can be no *carrying forwards* of *whole* numbers from one column of notation to another, in adding, or *borrowing* in performing subtraction, as in the columns of pounds shillings and pence in money calculations, &c.; but each column, when there are no decimals, concurs in shewing, independently, the same results, as far as they can be expressed therein; yet carrying and borrowing are sometimes used, at the rate of .14966096, &c. between f and Σ, and of .007862405, &c. between m and Σ.

The m and f, in Mr Farey's notation, are the smallest intervals that are yet known, we believe; but two others, d and F, occur in our Table, Plate XXX. Vol. II. between the latter and Σ, the largest term of this notation; which term was fixed upon, on account of the many important relations which the schisma (Σ) bears to other intervals; but Mr Farey has tried other notations of these small intervals, as follows, viz. $612d + 1848f - 559m = \mathrm{VIII}$, $612\mathrm{F} + 624f - 559m = \mathrm{VIII}$, $306r - 294f + 53m = \mathrm{VIII}$, $559\Sigma + 53d + 171f = \mathrm{VIII}$, $279\tfrac{1}{2}r + 53d - 108\tfrac{1}{2}f = \mathrm{VIII}$, $65r + 429\Sigma + 53\mathrm{F} = \mathrm{VIII}$, $65c - 12\mathrm{R} - 31\Sigma = \mathrm{VIII}$, $55\tfrac{7}{11}c + 12f - 2\tfrac{7}{11}m = \mathrm{VIII}$, $53c + 29\Sigma + 12f = \mathrm{VIII} = 53c + 12r + 5\Sigma = \mathrm{VIII}$, $12\varphi + 41c + 41\Sigma = \mathrm{VIII}$, $12\text{ƒ}c + 53c - 31\Sigma = \mathrm{VIII}$, $12\text{ƒ€} \times 53c - 19\Sigma = \mathrm{VIII}$, $12\pi + 41c - 19\Sigma = \mathrm{VIII}$, $12\mathrm{D} = 41c - 7\Sigma = \mathrm{VIII}$, $12\text{ƒ} + 29\text{€} + 22\Sigma = \mathrm{VIII}$, &c. Whence several different sets of artificial commas, of 1848, 624, 612, 559, 429, 306, 294, $279\tfrac{1}{2}$, 171, $108\tfrac{1}{2}$, 65, $55\tfrac{7}{11}$, 53, 41, 31, 29, 22, 19, 12, &c. respectively, in the octave, might now readily be calculated by that gentleman's manuscript tables of intervals. The first of which, 1848, would give a set of artificial commas, considerably more exact in the very smaller intervals, owing to the largeness of the numbers, than that by Σ, adopted by Mr Farey; but the notation, whence it is derived, for other reasons besides the negative sign in all its terms, is less adapted to general use than Σ, f, and m, and they would not prove in the least degree more exact, for all intervals larger than Σ. The notation that is adopted, besides furnishing Mercator's and Farey's artificial commas, contains another set of these (or of artificial half notes rather) in its middle column, which shews the number of degrees, or half-notes, or the finger-key, (12 in the octave,) to which any interval belongs, and which is of very considerable use in the practice of musical computations.

The musical student must, however, be on his guard in using the above, and all other artificial commas, in his calculations; always remembering, that when *whole numbers* of *one* interval only are used, that the same have no fixed or precise values, but vary, within small limits, (if the number in the octave is considerable,) in expressing every different interval to which they are applied. Thus, if 1 of Farey's artificial commas be supposed exactly to represent the schisma, or Σ, (and these commas cannot represent any *smaller* interval): then in Σ, the alto comma or 1 is 1.000000 Σ; but in 10 for the minor comma, or €, the same is 1.00078624; in 11 for c, each is 1.0007020; in 12 for đ, each is 1,0006552; in 21 for ℰ, each is 1.007488; in 57 for S, each is 1.0033154; in 104 for T, each is 1.0035585; in 197 for III, each is 1.0037173; in 358 for V, each is 1.0036072; in 612 for VIII, each is 1.0036154, &c. differing *in every interval*, and so they would do, on the supposition that $\tfrac{1}{10}$ €, $\tfrac{1}{11}c$, $\tfrac{1}{12}$ đ, &c. any one of them exactly represented this artificial comma; and yet the curious and admirable properties of these numbers are such, that, by adding and subtracting, they truly represent, and with the utmost facility perform, all the operations with intervals, as certainly as the logarithms, or the multiplication or division of the ratios can do, except with intervals smaller than, or very nearly equal to, the unit, or which do not differ from one another by more than this unit, or by some fraction of it; and hence the great advantage of a series of large numbers, like 612 in the VIII. But multiplication can only correctly be performed on these artificial commas in some cases, and division in still fewer cases, and only where there are no remainders after such divisions; and, generally, where fractions of intervals arise, as in all tempered systems must be the case, they cannot be relied on, or used, except as a rough check on more correct and difficult calculations; but in all such cases, either the three columns, as Σ, *f*, and *m*, or logarithms of some sort, (as the decimals of any *one* interval always are,) to a sufficient number of places, must be used in all calculations relating to temperaments, or other fractional intervals. See *Aristoxenian* Common Measures. (ϱ)

COMMON Measures, *Aristoxenian*, in music. These were, as Dr Holder expresses it, (*Treatise*, 1st edit. p. 149,) "Irrational contrivances for expressing the several intervals." Aristoxenus, and many others among the ancients, having vainly imagined, that by dividing all the principal degrees of the scale, or consonances, into all their aliquot parts, that some one, in each of all these sets of parts, would be found exactly equal to each other; and this small interval, to be found in the aliquot parts of every other one, was the least *common measure* of all the intervals, which they laboured incessantly to find. Had the ancients been able as quickly and accurately to extract the 12th, 30th, 72d, &c. roots of numbers, as we now can, and even of still higher numbers, almost without limit, by the help of a Table of Logarithms, as we have shewn, as to the 104th, 197th, 358th, and 612th parts of the T, III, V, and VIII respectively, in our article Common Measures above, this delusion must quickly have vanished; and it would have appeared, as we have shewn in the article above referred to, that an artificial comma has *a different value in every different interval* to which it is applied. But owing to the tedious and difficult labour of extracting the roots of the terms of musical ratios by arithmetical operations, and the impossibility almost of avoiding errors therein, it was not difficult for those engaged in these calculations, to persuade themselves and their followers, that they had made out certain of their roots, thus obtained, to agree exactly. And thus it should seem, that the 12th part of the major tone, the 30th part of the diatessaron, or fourth, and the 72d part of the octave, were known by the common name of the *Aristoxenian common measure*, and were supposed by many to be equal, and adapted accurately to measure these and all other intervals; and though others showed the absurdity and impossibility of this abstractedly, or in some particular cases, yet the doctrine could not be exploded entirely, until after the invention of logarithms, when it quickly vanished, like a mist before the sun. We shall, however, subjoin the most useful particulars of these measures, viz.

		Σ m	Σ	Com. Logs.	VIII. Logs.	C. Logs.
$\frac{1}{30}$th of the 4th	=	8.489514 + 1	8.497376	.9958353,7545	.0138346	.771937
$\frac{1}{72}$d of the VIIIth	=	8.522869 + 1	8.530731	.9958190,2784	.0138889	.774967
$\frac{1}{12}$th of the T	=	8.689645 + 1	8.697507	.9957372,8980	.0141603	.790117

Which Table may prove of considerable use to those who wish to examine the ancient musical writings, and see the extent of the errors into which such authors may have been led, by assuming the three intervals above to be one and the same. The last of the above intervals has been called the *duodecimal of a tone*, and supposed to equal the first of them; from which it differs nearly 1 in the fourth place of com. logs. or not much more than $\frac{1}{5}$ Σ: the middle one appears to be less than an arithmetical mean between the other two. (ϱ)

COMMON Law, is that branch or department of the municipal law of any state which is opposed to the edictal, legislative, or other *written* constitutions. It consists of those maxims, customs, and established usages, which, originating in the peculiar genius, local situation, military institutions, or other circumstances of a people, take root and gradually spring up in every country. Hence the different parts of it are not of equal antiquity, but have been successively recognised, as the maxim, custom, or usage was found to be consonant to the public sentiment, and had received a general adoption. What, therefore, formed no part of the common law of a country at one period of its history, came afterwards to be acknowledged as an important feature of it; and thus passing from one acquisition to another, as the changes in society produced correspondent changes in the public sentiments and manners, the common law of most countries has insensibly accumulated into an extensive system. The gradual departure, however, from ancient manners, has, in some instances, undermined this department of law; while in others it has been directly overthrown by positive enactment. A history, therefore, of the common law of any country, must furnish information of no ordinary interest and importance, since it is nothing else than a developement of the changes which take place on the sense of justice and morality among any particular people, in consequence of the changes which have taken place on their condition.

It is opposed to the *lex scripta*, or written law of a country, not because it cannot absolutely be said to be unwritten itself, but because, unlike the edicts of emperors, or the legislative enactments of free states, it is not originally promulgated in a written form. It gradually comes, however, to be firmly embodied in the same form; and the recorded decisions of the supreme courts are the authentic and mighty volumes in which it is chiefly to be read. A labour so impracticable, indeed, no understanding, however undaunted or absurd, could be expected to undertake; so that in most states where the study of the law is not obstructed from views of oppression, recourse has been had at an early period, and afterwards successively continued, to "reported cases," or abridgments of the most important decisions. These, when disputed, are of course authenticated by reference to the records themselves.

We have said, that the common law is *chiefly* to be found in the records of the supreme courts; for there are other repositories of it, though greatly inferior in extent, and also to a certain degree, in authority. These are the ancient sages of the law, whose writings either precede the time at which the decisions of the courts began to be regularly recorded and preserved; or which supply the deficiences of the records; or, by the wisdom and analogy of the observations they contain, have acquired an authoritative respect bordering on veneration. Thus, in England, Glanvil, Fleta, Littleton, and even so late a writer as Sir Edward Coke, are regarded as oracles of the common law. However, the authority of such writers depends chiefly upon the belief, that they are the faithful reporters of cases which, either by reason of their antiquity, or other causes of an accidental nature, are not now to be found upon record; and that they speak correctly the language of the maxims, customs, and usages of the times to which they severally relate.

In most countries of modern Europe, the civil and canon laws constitute likewise, more or less, a part of the common law. "But," as remarked by Blackstone, "all the strength which these laws have obtained in England, or in any of the other kingdoms of Europe, is only because they have been admitted and received by immemorial usage and custom in some particular cases, and some particular courts; and then they form a branch of the *leges non scriptæ*, or customary laws; or else, because they are in some other cases introduced by consent of parliament, and then they owe their validity to the *leges scriptæ*, or statute law."

In Scotland, the words *common law*, appear to have been sometimes used as synonymous with the civil or Roman law. Thus in statute 1540, c. 69; 1585, c. 18; 1587, c. 31, they are so used; and sometimes they employ the civil and canon law together: as in 1540, c. 80, and 1551, c. 22. It by no means follows, however, that either of these bodies of foreign law ever constituted, indiscriminately, and of their own proper authority, the common law of the country. On the contrary, when the common law proper to the country is meant, the statutory phrase is, *the common laws of this realm*, as in statute 1503, c. 79, and 1584, c. 131, where the ancient maxims and usages of Scotland, whether originating in the Roman, the canon, or the feudal institutions, or in whatever other source, are understood. So that, in the former instances, the phrase seems to resolve into a mere inaccuracy of expression. (J. B.)

COMMONS. See Parliament.

COMMONWEALTH. See Britain.

COMNENA Anna. See Anna Comnena.

COMO, Comum, or Novocomum, is a town of Italy, and capital of the department of Lario, beautifully situated on the southern extremity of the Larian Lake, or the Lake of Como. Excepting towards the lake, it is surrounded on all sides with fertile hills, and stands at the bottom of three green and wooded conical eminences, the middle one of which is crowned with a crested castle, stretching its ramparts down the declivity.

The houses are chiefly built of stone, and the public edifices are magnificent. The cathedral, which was repaired at the expence of Innocent XI. is of a mixed style of architecture, and is constructed of white marble. The front is in a light Gothic style; the nave is supported by Gothic arches; the choir and transepts are adorned with composite pillars; and the whole is surmounted with a dome over the centre. There is a statue of Pliny the Younger, who was born in Como, placed in a niche in the front of the cathedral, with basso relievos, alluding to his writings, and inscriptions in his honour on each side of the grand entrance. Besides the cathedral, there are about 12 other churches, some of which are ornamental to the town. That of St Giovanni is decorated with several columns, which are supposed to have been taken from a portico which Pliny mentions as having been built by his wife's grandfather Fabatus. There are likewise in Como three colleges of considerable reputation, and three public libraries.

Como is a town of great antiquity, and appears to have been founded by a colony of Gauls under Brennus. Its importance was increased by a colony of 500 Greeks, all of whom were persons of quality, who were carried there by Julius Cæsar. In the time of Pliny it appears to have been a flourishing and opulent city, surrounded with large and magnificent villas, and decorated with temples, statues, porticoes, and pillared gates.

The inhabitants are very industrious, and have the character of making good soldiers. Several manufactures of cotton, silk, and velvet, are established in the town, and a small trade is carried on with the Grisons. Mr Eustace, who visited this town in 1802, makes the population 20,000, whereas Tynna, in his *Almanach du Commerce, pour* 1811, where the population of French towns is generally exaggerated, makes it only 7000. East. Long. 9° 5′ 41″, North. Lat. 45° 48′ 22″. See the Rev. John Chetwode Eustace's *Classical Tour through Italy*, vol. ii. p. 363, &c. Lond. 1813; *Viaggio ai tre Laghi Maggiore, di Lugano, e di Como, &c.* di Carlo Amoretti. Milan, 1803; and *Tableau Historique Statistique et Morale de la Haute Italie, par* Ch. Denina, p. 248, 388. Paris 1805. (π)

COMO, Lake of, the *Lacus Larius* of the ancients, is a lake of Italy, which stretches between two chains of mountains at the foot of the Alps. It is about fifty miles long, from three to six broad, and from 40 to 600 feet deep. It is of a serpentine form, and has its banks indented with numerous creeks and harbours. It is subject to sudden squalls, and to violent and unexpected swells. The lower regions of the mountains with which the lake is encircled, are covered with olives, vines, and orchards: the middle regions are encircled with groves of lofty chesnuts, and the higher regions are either downs or forests of pine and fir, the most elevated ridges being either naked or crowned with perpetual snow. "Their sides," says Mr Eustace, "are seldom formed of one continued steep, but usually interrupted by fields and levels, extending sometimes into wide plains, which supply abundant space for every kind of cultivation. These fertile plains are generally at one third, and sometimes at two-thirds of the total elevation. On or near these levels are most of the towns and villages that so beautifully diversify the sides of the mountains. Various mines of iron, lead, and copper, are now, as they were anciently, spread over the surface of the Larian territory, and daily opened in the bowels of its mountains; besides quarries of beautiful marble, which supply Milan and all the neighbouring cities with the materials and ornaments of their most magnificent churches."

At a village called Pliniana is the intermittent fountain, so minutely described by Pliny. It bursts from a rock in a small court behind the house, and increases and decreases thrice every day, although the ebb and flow are sometimes irregular.

The principal places worthy of being noticed by a traveller are, the little wooded island of St Giovanni, the villages of Balbiano, Lenna, and Villa, the last of which is supposed to be the site of Pliny's villa; the promontory and village of Bellagio, the village of Cadenabbia, which should be the head quarters of a traveller who wishes to explore the lake; Bellano on the opposite side of the lake; the cavern of L'Orrido; the village of Capriano, supposed by some to be the real situation of Pliny's lower villa, the stream and cascade of Latte, and Menaggio from which there is a full view of the lake from Bellagio to Garedona and Domaso.

Comocladia || Company.

Beyond Domaso the lake of Como receives the Adda, after which its channel is narrowed, and it takes the name of the Lago di Chiavenna. See the works quoted in the preceding article. (*π*)

COMOCLADIA, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 97.

COMORA ISLES, is a cluster of islands situated in the channel of Mozambique, between the northern extremity of Madagascar and the coast of Zanguebar in Africa. The principal islands are Johanna, Mayotta, Mohilla, Angazi, and Comora. The Portuguese, by whom they were discovered, treated the inhabitants with such cruelty, that almost all those who have since visited those islands have been either massacred or ill received. More recently, however, the inhabitants, who are negroes of the Mahommedan religion, are said to entertain European seamen with considerable humanity. The islands abound in horned cattle, hogs, and sheep, and produce sweet and sour oranges, citrons, bananas, honey, sugar canes, rice, ginger, and cocoa nuts. E. Long. between 43 and 45°, N. Lat. from 1° to 14°. (*j*)

COMPANY, (Fr. *compagnie*, derived from the Latin *cum* and *panis*,) means properly "an assemblage of several persons in the same place, or for the same purpose." In the sense in which it is generally taken, and in which it becomes an object of explanation in this article, it denotes an association of a number of merchants. We say a "number," because the word *partnership* is generally applied to a limited association. Company, besides, is currently understood as the designation of a body of men conducting trade, with particular privileges, or under specific exemptions;—partnerships, on the other hand, have no particular privileges.

A branch of commerce carried on with an uncivilized people may require, particularly in the commencement, more protection than the circumstances of unconnected merchants can afford. In such cases, a fort and a garrison may be necessary; as well as a diplomatic agent, for the purpose of maintaining a good understanding with the government of their rude neighbours. These considerations, varying materially in different quarters, have given rise to mercantile associations of two kinds; regulated companies, and joint stock companies. The former should hardly be called companies, according to the current acceptation of the word, as they are obliged to admit any person properly qualified, who will pay a moderate fine, and submit to their regulations. This done, the new member proceeds, like his predecessors, to trade on his individual capital, and at his own risk. A regulated company, therefore, bears a great resemblance to an incorporated trade in a town, the object in either case being the exclusion of all those persons who have not performed certain specific obligations. The fact, however, is, that improvements in commerce have so much facilitated the admission of merchants into our regulated companies, that little attention is paid by the public to the nature of their constitution. Their names even are not familiar to mercantile men. The regulated companies in this country are five in number, and are called the Hamburgh, the Russia, the Eastland, the Turkey, and the African company.

Turkey company

In looking back to former records, we are led to judge, from the complaints of manufacturers and others, that these companies possessed and exercised power in a manner very different from what we see at present. The Turkey company, for example, enacted by a bye-law, that all British goods for that empire should be shipped in their vessels exclusively. Another bye-law purported, that no persons who were not freemen of London should be allowed to become members of the company. The pretext for these regulations was the necessity of excluding from the traffic individuals whose conduct might give offence to the Turks. The restrictions, however, were found very injurious, and abrogated, in a great measure, by an act of parliament in 1753, which laid open the trade to persons out of London. In regard to the Eastland and the Russia Companies, the admission is now so easy as to be procured for a few pounds.

African company.

The latest institution in the shape of a regulated company was the African, established by act of parliament in 1750. The object of it was to provide for the maintenance of certain forts and garrisons on the western coast of Africa. A sum, generally L.13,000, was annually voted to them for that purpose by parliament; but in spite of all the precautions taken in drawing up the charter, the directors of this association have been accused of neglecting the charge entrusted to them.

Joint stock companies.

Joint stock companies come next to be considered, and will be found a more important and interesting subject. Their leading characteristics, as distinguished from private trading companies, are two; exemption of the individual member from responsibility beyond a specific sum, and liberty to sell the share held in the capital whenever he thinks proper. This limitation of risk, coupled, as it generally is, with exemption from trouble, recommends joint stock companies to many persons who, from situation, would not otherwise think of vesting money in trade. These persons, however, must not flatter themselves that any united company can long maintain a competition with the vigilance and activity of private traders. The directors find themselves the managers rather of other persons' property than of their own, and abuses infallibly creep in. We have seen under the article COLONY, the failure of joint stock companies in one nation after another, in a kind of regular succession. Such has likewise been the lot of the English African companies, of whom we have had, from first to last, no less than four distinct associations. The South Sea company were exempt from one great article of expence, the maintenance of forts and garrisons, but their example is equally discouraging as that of others. Their stock-jobbing projects belong to history, and are too legibly written in characters of national misfortune to require animadversions in this place. But their mercantile arrangements are less generally known. Aided by an exclusive privilege, they engaged to supply the Spanish West Indies with negroes, and were allowed, as a special advantage, to send an annual cargo of merchandise to that far-famed market. Yet, of ten annual voyages of this description, one only was profitable to the company as a body, whatever may have been the individual gains of their servants. The result was, that the company petitioned and obtained leave from government, to treat with the court of Spain, for a consideration, for the relinquishment of the privilege of importing this annual cargo. The Greenland trade being undertaken by this hopeful association, was conducted in the same style; and was wound up in 1730, with a loss, in the course of eight years, of L. 237,000. As many persons are not apprised how South Sea stock continues a valuable property, after the total failure of the projects of the company, it is proper to add, that their capital (nearly thirty-four millions sterling) was lent to government. In 1722, it was agreed that half this sum should be put on the same footing as

South Sea company.

other government stock, and exempt from the debts or losses attendant on mercantile adventure. In 1733, the same character was given to a farther portion of the stock, and in 1748 to the whole.

Hudson's Bay company.

The Hudson's Bay Company have been cited as an example of successful management on the part of a joint stock association. The fact, however, is, that their transactions are of very limited compass, and much less productive of profit than has been represented. Neither are they an example of the benefit of exclusive privileges, their charter, which was dated in 1670, being from the crown only, and not confirmed by parliament. It consequently contains no legal prohibition of the interference of private traders. Their transactions accordingly fall more properly under the description of well-managed partnerships, than of extensive companies.

East India company.

Our first India company was chartered, not by parliament, but by the crown, in 1600. It became a joint-stock association in 1612. In course of time, private traders, questioning the legality of a charter not confirmed by parliament, ventured to interfere with their commerce, and exposed them, towards the end of the seventeenth century, to the losses attendant on a formidable competition. In 1701, the charter having expired, the public saw the unusual occurrence of two joint stock companies pursuing the same branch of commerce. In 1708, they were consolidated into one company, under their present name; and in 1711, the competition of private traders was finally removed. Soon after the middle of last century, this company gradually augmented their dividend from 6 to 10 per cent. In 1767, government laying claim to their territorial revenue, as the property of the crown, the company bargained for its retention, by agreeing to pay government a sum of L. 400,000 a-year. The most flattering accounts of their finances were exhibited; but unfortunately their debts still continued on the increase. Great disorders prevailed in the management of their India affairs; and the expence of war with Hyder Ali, reduced them to the necessity of applying to government for relief. Since that time, the wars with Tippoo, Scindiah, and Holkar, along with the continued disadvantages inseparable from a joint stock company, have reduced their affairs to that situation, in which most associations of the kind have been obliged to make their exit. The complication of their accounts, and the popular notion of wealth still attached to the name of India, have long prevented the public from being aware of their real condition. And government, appreciating the utility of many of their institutions in India, as well as desirous of avoiding a shock to public credit, have conducted the change, now become necessary, with much delicate attention to the company. The internal government of India, and the China trade, their only lucrative branch, have accordingly been left in their possession.

Such being the general, we may almost say the universal, lot of joint stock companies, it becomes a question, whether such institutions are, under any circumstances, advisable? In the case of a new trade established with a remote and barbarous nation, Dr Smith approves of a temporary monopoly, on the same principle as of the monopolies granted by patent for the invention of machinery. But on the expiration of a specified term, the monopoly ought certainly to close, and the public buildings that may have been found necessary, should be taken over by government, the trade being laid open to the public at large. The Abbé Morellet gives a list of fifty-five joint stock companies for foreign trade, established in different countries of Europe since 1600, all of whom have been unsuccessful. In fact, the only mercantile undertakings which it seems possible for a joint stock company to carry on advantageously without an exclusive privilege, are those of which all the operations are capable of being reduced to mere routine, that is, to the application of a few plain and constant rules. The branches enumerated by Dr Smith as coming under this description, are four in number: banking—insurance from fire, sea risk, and capture—the making of navigable canals—and, lastly, the supplying a great city with water. This enumeration was apparently suggested, more by an observation of the branches which had actually succeeded in England, than by any deduction from previous reasoning. The making of a navigable canal, or of extensive water-pipes, are attended with no peculiar facilities beyond the excavation of a dock, a speculation not admitted into Dr Smith's list of eligible undertakings. On the other hand, the insurance of merchantmen against capture, is one of the most varying and difficult calculations in the whole circle of mercantile adventure. We prefer, therefore, Dr Smith's general rule to his particular list, and are disposed to infer, that as society advances, and the principles of different branches become better understood, the appropriation of the vast sums which characterise the capitals of joint stock companies, will be found to embrace a greater variety of undertakings. It becomes in every age more generally the practice, to divide a large concern into various departments, and to make contracts on the plan of performing work by the piece. The consequence is a succession of checks, by these improved arrangements, to the mismanagement which is inseparable from a public board, so long as the conduct of affairs remains discretionary. At the same time, the possession of exclusive privileges should be granted with a very sparing hand; and, in a recent case of this description, the West India Dock Company, we have understood, that the obligations imposed on the trade at large have given rise to various complaints.

In looking around to our continental neighbours, we see frequent examples of loss incurred in consequence of joint stock associations undertaking branches of trade unsuitable to the circumstances of their respective countries. Sweden and Denmark, for example, are too bare of capital for so remote a trade as that of India, where the returns seldom come round in less than two years. Their true policy would be to occupy themselves with a traffic in their own neighbourhood, and with countries such as England and Holland, where the risk is small, and the payment prompt. The arguments in behalf of joint-stock companies, founded on the plea of an impossibility of otherwise managing the trade, should be received with great caution. The Portuguese, certainly not the most temperate of European nations, conducted the India trade above a century on the plan of separate adventure. In China, accounted the most difficult of all countries to manage, the Americans of the present day find no particular inconvenience from dispensing with the regulations of a united company. M. Say, one of the most enlightened disciples of Dr Smith, in admitting (vol. ii. p. 196) the peculiarity of Chinese customs, maintains, that individual merchants are just as likely to behave with the requisite caution, as the officers or agents of an established association. He enters, concisely indeed, but with much force of argument, into the various disadvantages of

Company.

privileged companies. It is, he says, a bad sign in the outset, that special encouragement should be required for the purpose of giving a particular direction to a portion of the national capital. After all that has been said of the profit attendant on a direct intercourse with such countries as India and China, does it appear, he asks, that the nations who buy tea and piece goods at second hand, pay much more for them than the original importers? On making a strict analysis, it will be found that the chief profits of a privileged company are extracted from the pockets of their own countrymen. Whatever sum is paid by a consumer beyond the rate at which a free traffic would supply the article, is so much money lost to the public. Moreover, no concerns are more liable to suffer by the langour attendant on the proceedings of a board composed of men acting for others, than the remote and complicated affairs of India. A director of the French East India Company asked M. La Bourdonnaye, "how it had happened that he had managed his own affairs so much better than those of the Company?"—"The reason," said the other, "is plain; my own affairs are managed according to the judgment formed on the spot, while, in regard to public concerns, I was obliged to follow orders from a distance."

In investigating the motives which have so frequently induced governments to lend themselves to the views of persons projecting exclusive companies, we recognise the influence of two prominent reasons; first, a prospect of gain is held forth without discovering at whose expence; and, in the next place, these flattering profits may be reduced in the most plausible way to numerical calculation, while the consequent loss, being indirect, obscure, and general, wholly escapes observation. The general result of the facts and reasoning brought forward in this article may be expressed as follows: Exclusive privileges, if they ever were advisable, become less and less necessary as society advances. On the other hand, the exemption from unlimited responsibility, and the unrestrained permission to bring to sale a share in the property of a company, the two principal features in the constitution of a joint stock association, become more and more applicable as improvements take place. Both alterations are in correspondence with that admirable system which an intimate knowledge of political economy opens to the mind of the attentive observer. Exclusive privileges are at variance with that liberty which constitutes the basis of trade; while the exemptions which we have specified are merely examples of the extension of the principle. It has been thought expedient to make every partner in a private mercantile house responsible to the creditors of the concern to the last shilling of his property; a precaution rendered necessary by the unacquaintance of the public with the amount of property invested in the concern. But in the case of a public body, the capital is matter of notoriety, and the responsibility of the individual partners admits of limitation, without injury to the creditors of the company. (χ)

Company || Complement.

COMPASS. See MAGNETISM.

COMPASSES. See DRAWING INSTRUMENTS.

COMPENSATION BALANCE. See TIMEKEEPER.

COMPLEMENT, in music, is applied to such intervals as, with some other given one, make up the octave, or eighth; thus, if a major third be given, as CE, its complement is the minor sixth E *c*; if a minor third CE♭, its complement is the major sixth E♭*c*, &c.; and it may be proper here to note, that a *major* interval is always the complement of a *minor* one, and *vice versa*; and that these intervals are always expressed by the same letters, but in reversed order, as above. It may be proper further to remark, that if any interval be a concord, its complement is the same also; and if a discord, its complement is a discord also: and, that if any interval be tempered flat or sharp, its complement has just a similar temperament sharp or flat, or the reverse of the former; thus, $V - \frac{1}{4}c$, has $4th + \frac{1}{4}c$ for its complement, in the mean tone system; $V - \Sigma$ has $4th + \Sigma$, and $III + 7\Sigma$ has $6th - 7\Sigma$, for their complements, in Farey's *Equal Temperament*. (ϱ)

COMPONENT PRIMES, in music, is applied to the integers 2, 3, and 5, which enter into the composition of the ratio of any interval; thus, of the major comma, whose ratio is $\frac{80}{81}$, the component primes are $\frac{2^4 \times 5}{3^4}$, or, the 4th power of two multiplied by 5 for a numerator or least of the terms, and the 4th power of 3 for a denominator, or largest of the terms. (ϱ)

COMPLEXION

Complexion.

GIBBON has remarked, that the extraordinary phenomenon of the great and extreme variety in the human complexion, as in some instances it appeared to proceed from the influence of climate, and in other instances to resist it for a long series of years, which has roused and exercised the speculation of modern philosophers and theologians, was passed over, almost unnoticed, and certainly uninvestigated, by the ancients. Their attention was indeed called to the general and striking fact, that under the burning climates of the globe, the human complexion was of the darkest hue: the fable of Phaeton, invented or embellished by the poets, contained in it such an easy and satisfactory solution of this circumstance, that in its more sober and philosophical interpretation, it was adopted and acquiesced in by the natural historians of antiquity; but neither their opportunities of information enabled them, nor, had they possessed these, would their mode of philosophising have led them to detect, and speculate on the exceptions to the general fact, that the blackness of the human complexion increased or diminished according as the country approached or receded from the equator.

Opinions of the ancients.

Even the blackness of the Ethiopian, (for this name they seem to have given to all the nations who had this complexion, whether they had inhabited Africa or Asia), though it excited the wonder and astonishment of the ancients, did not induce them to enter very fully or minutely into the investigation of its cause. Hippocrates, Aristotle, and Pliny, merely touch upon it rather individually, than with any settled purpose of treating it in a full and satisfactory manner. Pliny, indeed, from the information which the Romans, by their conquests in Gaul and Germany, had gained respecting those nations, was enabled to illustrate and to strengthen the hypothesis which was contained in the fable of Phaeton, and, coinciding with it, in ascribing the

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blackness of complexion, and crispature of hair, which distinguished the Ethiopians, to their vicinity to the sun, he attributes the fair complexion and yellow hair of the northern nations of Europe, to the coldness and moisture of the climate under which they lived.

This hypothesis, so conformable to the most notorious and well-established facts, and which seemed to be firmly grounded on philosophical principles, remained for a long time undoubted and undisturbed, amidst that superior information and more strict and scrupulous mode of reasoning, which entirely destroyed, or greatly modified, the conjectures and opinions of the ancients on other points of physical science; it was even strengthened among the moderns, by the circumstance, that religion was supposed to lend its authority to its truth. A disposition and tendency to call it in question, and certainly an absolute rejection and disbelief of it, cannot, we apprehend, be traced farther back than the end of the 17th century; and what is worthy of remark, one of the first who maintained that climate alone could not produce the negro blackness, was Mr Boyle,—a name which ought to secure this opinion equally, and at once, from the charge of want of philosophy and want of religion. Boyle's *Works, abridged by Shaw—Experiments and Observations on Colour*, vol. ii. p. 42.

The full and methodical discussion of this curious and important subject, requires that we should call in the aid of physiology, as well as of the geographical history of man; and that we should, in the first place, endeavour to ascertain the seat of colour in the human body; secondly, that we should examine the different hypotheses which have been thrown out, to account for the *immediate* cause of colour; the varieties of human complexion ought next to be collected and classed; and, finally, the influence of climate in producing these varieties, must be investigated and ascertained.

On the seat of colour in the human body.

I. The human skin, till the time of Malpighi, was supposed to consist only of two parts; the cuticle, epidermis, or scarf-skin, and the cutis or real skin; but that anatomist, about the middle of the 17th century, discovered between these a cellular texture, soft and gelatinous, to which the names of *rete mucosum*, and *corpus reticulare*, have been given. He demonstrated the existence of this membrane at first in the tongue, and in the inner parts of the hands and feet; but by his subsequent labours, and also by those of Ruysch and other anatomists, it has been proved to exist between the epidermis and the cutis in all parts of the human body.

Malpighi, on the discovery of this membrane, offered a conjecture respecting the cause of the colour of negroes: he supposed that this membrane contained a juice or fluid of a black colour, from which their blackness arose: the actual existence of a black pigment has been since ascertained, but has never been procured in sufficient quantity to admit of minute and analytical examination.

The rete mucosum is of very different colours in different nations; and the difference of its colour so completely agrees with the difference of their complexions, that there can be no doubt that it is the sole, or at least the principal seat of the colour of the human complexion. Its thickness varies in different parts of the body; and the depth of its colour, for the most part, is in proportion to its thickness. Where the cuticle is thickest, there it is also found of the firmest and thickest texture; and it is most easily detected in the palms of the hands, and in the inner parts of the fingers, and on the soles of the feet. There appears, however, one exception to this general rule. According to Kaaic, "in pudendis vero tenue, sed fuscum ita, ut negares de Europæi cute detractum esse." *Perspiratio dicta Hippocrati, per Universum corpus Anatomice illustrata, Auctore* Abrahamo Kaaic, M.D. Lug. Bat. 1738, p. 21.

Although this circumstance of the different colours of the rete mucosum corresponding exactly with the different complexions of the human race, seems satisfactorily to fix the seat of colour in that membrane, yet some authors are of opinion, that the black complexion of the negroes arises, partly at least, from the cuticle. This opinion is particularly maintained by Dr Mitchell, in his "*Essay on the Causes of the different Colours of Persons in different Climates.*" Phil. Trans. abridged by Martyn, vol. x. p. 926. "The cuticle of negroes," he says, "is much thicker than it is in people of a fair complexion; and hence, it cannot so easily or perfectly transmit the colour of the cutis through it." But it is evident, that even allowing the fact on which this reasoning is founded to be true, namely, that the cuticle of negroes is much thicker than that of fair complexioned people, it will rather militate against, than support the inference which he draws from it; since, if the thickness of the cuticle weakens its power of transmitting colour, the black colour of the rete mucosum can have little or no effect in producing the black complexion of the negroes.

But though the cuticle cannot, in this manner, give rise to the colour of the human complexion, there is reason to suppose, that in some degree, and in some cases, it contributes to this effect. Kaaic maintains, that this membrane, even when separated from the rete mucosum, is found to possess different colours in different nations; and that it also varies in men living under the same climate. That this variation does not arise entirely from different degrees of exposure to the sun and air, clearly appears from an experiment which this anatomist made. He macerated the cuticles of twins, and separated the rete mucosum; the colour of the cuticles he found to differ in a considerable degree.

The black colour of the negroes is destroyed by several causes; indeed whatever destroys the rete mucosum destroys it, as wounds, burns, &c. and as this membrane is never reproduced, the scar remains white ever afterwards. Hawkins, in his *Travels into the Interior of Africa*, (p. 120.) mentions, that the land-cloud of Africa, called by the Portuguese *ferrino*, changes the black colour of the negroes into a dusky grey; according to some other authors, the change is into a red copper colour. At Darfur, a species of leprosy prevails among the natives, which they call *borras*, and which gives them the appearance of being pie-bald, changing to a white colour parts both of their skin and their hair. *

There are also several instances of the colour of negroes being either entirely or partially changed from the operation of causes, which cannot be detected or explained. A boy who was born in Virginia, of black

* Browne's *Travels in Africa, Egypt, and Syria*, p. 332.—There are several kinds of fish in the West Indies, which, when eaten, alter the colour of the negro. Dr Clark of Dominica particularly notices this:—"A singular effect of fish poison, is to remove the epidermis in patches or spots, about the hands and feet, which continue white in people of colour, and of a pale yellow colour in white people, for life.—*Medical Facts*, vol. vii. And Dr Isert saw a negro, in his travels through Guinea, whose hands and feet were perfectly white, in consequence of a severe illness, probably occasioned by eating poisonous fish.—*Reise nach Guinea*, p. 175.

parents, continued of his native colour till he was three years old: at that period a change of colour began to take place, though the health of the boy continued good, and there was no assignable cause for the alteration in his food, or mode of life. At first white specks made their appearance on his neck and breast, which soon increased in number and size; from the upper part of his neck down to his knees, he was completely dappled; his hair was also changed, but not to the same degree, since, though some parts of it were white, in general it retained the black colour and crispature of the negro. The colour of those parts of his body which had undergone the change, was of a more livid white than is found among the fairest Europeans; nor did the flesh and blood appear through these parts of his skin so clear and lively as through the skin of white people. He was not liable to be tanned. *Philosophical Transactions*, vol. xix. p. 781.

It has been already mentioned that burning renders the negro skin white; and this cause might have been supposed to have operated in the following instance, had it not been expressly mentioned that the person was always well clad, and that the parts exposed to the kitchen fire were not more particularly affected than such parts as were not so exposed. A cook-maid, a native of Virginia, whose skin was originally as dark as the most swarthy African, underwent a change of complexion when she was about 25 years of age: this change made its first appearance on the skin near the finger nails; the skin of the face, particularly near the mouth, was afterwards affected; and the change gradually proceeded, till at last four parts out of five of her face and body became white; her neck and back remained the blackest. This change was different in its nature from that of the former case; for, in this instance, the skin became transparent, similar to that of a fair European, so that blushes could be discovered, and freckles took place; the hair was also changed to white on those parts of the body which had become white, while it continued black on those parts which preserved their native colour. *Philosophical Transactions*, vol. xli. p. 176.

But the case most similar in its nature, and most particularly described, is given in the *Manchester Transactions*, vol. v. part 1. p. 314. The paternal grandfather of Henry Moss, (the person in question,) was born in Africa, and married a native Indian of Pennsylvania. His father married a mulatto, born of an African father and an Irish mother. His maternal grandfather was born in Africa. He himself, till he arrived at the age of 40, was of as dark a complexion as any African: a change of colour then began to take place; it commenced at the skin near the root of his finger nails. It is remarkable that the change proceeded most rapidly and regularly, during the summer season; during winter it either was entirely suspended, or went on so slowly as scarcely to be perceptible. He felt, or fancied himself, more sensible to variations of temperature, after this change of colour took place, than he had been before. The change in the colour of his hair proceeded along with the change in the colour of his skin; and wherever it became white, it became also soft, like the hair of Europeans, and could be drawn out to the length of several inches. Mr Fisher, who transmitted the account of this phenomenon, ascertained that the change of colour was not external, but a change of the *rete mucosum*; for when he pressed the skin it appeared white, and on the removal of his finger, it was suffused with red, as in Europeans.*

The oxymuriatic acid has a temporary effect on the black pigment, which exists in the *rete mucosum* of negroes. Dr Beddoes subjected the fingers of a negro to the action of this acid; the skin was whitened, but the black colour returned in a short time. This experiment has been repeated on the feet of a negro. They were kept for a considerable period in water, impregnated with oxymuriatic acid, which deprived the rete mucosum of its colour, and rendered it nearly white; but in a few days the black colour returned with its former intensity.

II. Various hypotheses have been suggested to account for the *immediate* cause of the black complexion of negroes, by Mecket, Pauw, Walter, Kant, Blumenbach, Rush, and Humboldt.

Hypotheses of Mecket and Pauw.

1. The hypotheses of Mecket and Pauw nearly coincide, and seem to have been derived from an observation of Herodotus. This historian asserts that the spermatic fluid, both in the eastern and western Ethiopians, is not white as in other men, but black like their skin. (*Herodotus Thalia*, cap. 101.) This opinion is expressly denied by Aristotle, but it is supported by the authority of Le Cat, in his *Traitè sur la Couleur de la Peau*. From this colour of the spermatic fluid, Mecket and Pauw supposed that all the other fluids of the negroes received a dark tinge. The former believed that the liquor which colours the medullary substance of the brain, was darker coloured in the African than in the European; this he supposed arose from the colour of the spermatic fluid, and being secreted by the cutaneous nerves into the viscous reticular substance, contributed towards the dark complexion of the mucous membrane.] But Soemmering expressly denies the allegation on which this hypothesis rests: he could not observe the smallest difference in colour, either in the ceneritious or medullary parts of the brain of an African and European; and, notwithstanding the authority of Le Cat, the blackness of the spermatic fluid of the negro may very justly be doubted.

Of Walter.

2. Professor Walter is of opinion, that the blood of negroes is of a darker colour than that of Europeans, and that this is the cause of their dark complexion. This opinion is also maintained by Town, in his Paper on the Blood of Negroes, in the *Philosophical Transactions*; and Professor Soemmering seems rather disposed to adopt it; but the fact is very questionable. Professor Camper asserts that the blood of negroes is not darker coloured than is frequently found among Europeans; and Dr Winterbottom, who must be allowed to be a competent judge on this question, expressly maintains, "that there is no perceptible difference in the colour of the blood of an African and European." Winterbottom's *Account of the native Africans in the neighbourhood of Sierra Leone*, vol. i. p. 191.

3. Kant, Blumenbach, and Humboldt, offer different

* It is probable that similar changes of colour frequently take place among the negroes, in their native land, without any assignable cause. Mr Winterbottom says, "it is not uncommon to see persons, whose skins have undergone a change from black to white, the appearance being confined to only a small part of the body. Sometimes one or both hands and feet are spotted black and white; sometimes they are entirely white. The Bullones compare this disease to a caterpillar, variegated black and white, which they call *unnah*, and hence they name the disease *ker'unnah*, or spotted worm. This change of colour is not produced by any injury done to the skin. The natives appear ignorant of the cause of this curious phenomenon. Some blame particular kinds of food, while others more prudently confess their ignorance."—Winterbottom's *Account of Sierra Leone*, vol. ii. p. 173.

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Hypotheses of Kant, Blumenbach and Humboldt.

modifications of a chemical hypothesis, to account for the dark colour of the *rete mucosum.* The first of these authors supposes that the blood of negroes abounds in iron, which is precipitated into this membrane by the phosphoric acid. Blumenbach is of opinion, that the carbon which abounds in the body is thrown off by the *cutis vera,* united with hydrogen, but is decomposed by the access of the oxygen of the atmosphere, while the carbon remains fixed in the *rete mucosum;* and Humboldt ascribes the dark complexion of the Indians of South America to the abundant deposition of carburetted hydrogen in the *corpus mucosum;* or *reticulatum* of Malpighi; this, he supposes, not only is the proximate cause of darkness of complexion, but also of the fact, that those races in which it exists retain their native colour, even under the influence of a colder climate.

4. The remaining class of hypotheses rest on a different foundation. Blumenbach, besides giving it as his opinion that the proximate cause of the dark colour of the rete mucosum is the abundance of carbon which remains fixed in that membrane, endeavours to account for the secretion of this substance in such quantity. Hot climates, he says, exert a great influence on the liver: an unnatural state of the bilious secretion being thus produced, and increased through many generations, the vessels of the skin secrete a greater abundance of carbon than in colder climates. But this hypothesis is extremely weak and ill-founded; besides involving the idea that the negro race are constantly labouring under hepatic disease, it is directly contradicted by the fact, "that bile has no power in producing a permanent change in the colour of the skin; and sickness, which in hot climates causes the skins of Europeans to assume a yellow hue, changes that of the African to a lighter colour." Winterbottom, vol. i. p. 190.

Of Rush.

Dr Rush has advanced an hypothesis of a similar nature to that just noticed, but still more weak and liable to objections;—he supposes that leprosy is the cause of the black complexion and woolly hair of the negroes: it will be sufficient to state two of his arguments to prove how hard he is pushed to support this opinion, and how very absurdly, after all, he does support it: leprosy is accompanied, in some instances, with a black colour of the skin, therefore the black complexion of the negroes arises from this cause; but leprosy is also described, as giving rise to preternatural whiteness; hence this disease may also be considered as the cause of the singular complexion of the Albinos, or white negroes. His mode of accounting for the woolly hair of the Africans on this hypothesis, is equally unphilosophical: some medical writers look upon the *plica polonica,* as a species of leprosy, but the hair in the *plica polonica,* bears some slight resemblance to the hair of negroes, therefore the leprosy is the cause of two of the most distinguishing characters of this race, the blackness of their complexion and the crispature of their hair. This kind of reasoning is not unworthy of the man, who, in the same paper, could express his belief, that two women had become black, and got the features of negroes, by living with negro husbands. This, too, is an additional proof, that all negroes are lepers, as it puts it beyond a doubt that they are infectious. See *American Transactions,* vol. iv. p. 289, &c.

Classification of the varieties of the human complexion.

III. The different varieties of human complexion have been classed by several authors: the classification of Blumenbach, with some little alteration, is the most clear, methodical, and satisfactory. We shall give his classification of the more striking features, as well as of complexion, because, from the union and concomitancy of particular sets of features, with particular kinds of complexion, an argument will afterwards be drawn respecting the influence of climate on the human complexion.

According to this author, there are five varieties; the Caucasian, the Mongolean, the Malay, the Ethiopian, and the American.

Caucasian variety.

1. In the Caucasian variety, the skin is white, or rather brownish; the cheeks are red, and the hair of the different shades, from black to yellow, or red. The form of the head is nearly globular; the face oval and straight; the forehead expanded; the nose narrow at the base, and rather aquiline; the mouth small; the lower lip a little turned out, and the chin full and rounded. In this variety, Blumenbach includes all the Europeans except the Laplanders, the western Asiatics, including the Georgians, Caucasians, Persians, Arabians, &c. the northern Africans, and the Abyssinians. At first, he was disposed to arrange the Egyptians in this variety, but afterwards he altered his opinion, and placed them between the Circassian and Ethiopian. *Observations on some Egyptian Mummies, by* J. F. Blumenbach, *in the Philosophical Transactions for* 1794. The Gothic or German race, has also been taken out of the Caucasian variety by Dr Pritchard, and formed into a separate class, under the name of "*Constitutio Germanica aut Sanguinea.*" (*Disputatio inauguralis de hominum varietatibus.* Auct. J. C. Pritchard.) This has been done, rather on account of their difference in complexion than in features. They are characterized by blue eyes, flaxen hair, and very fair skin; their features are more rounded, and their eyes smaller than those of the nations which form the Caucasian variety. The Danes, Norwegians, and Icelanders, exhibit the peculiar features and complexion of the Gothic race, in their purest state.

Mongolian variety.

2. In the Mongolian variety, the colour is olive, the hair black, strong, and straight; seldom curled, or in great abundance: head of a square form; face broad and flattened; nose small and flat; eyes placed very obliquely; chin projecting slightly; the ears large, and the lips thick. This variety comprehends all the Asiatic nations to the east of the Ob and the Caspian, except the Malays; and according to Blumenbach, it also includes the Laplanders, Esquimaux, Samoieds, &c.; but Dumeril forms a separate variety of these, and the other tribes, who dwell near the north pole, under the name of the Hyperborean variety.

Malay variety.

3. The colour of the Malay variety is brown; their hair black, soft, curled, and abundant; their head is rather narrow; their nose full and broad towards the apex; their mouth large. The peninsula of Malacca, the islands near it, and those of the South Sea, are inhabited by this variety.

Ethiopian variety.

4. The Ethiopian variety have black skin and eyes; their hair is black and woolly; head narrow and compressed laterally; eyes prominent; their nose and lips, particularly the upper one, thick; and their chin receding. This variety comprehends all the Africans, except those which are placed under the Caucasian variety.

American variety.

5. The American variety have a red complexion; their hair resembles that of the Mongolian variety; their eyes are deep set; their nose rather flattened, and their face broad. All the inhabitants of the New World, except the Esquimaux, are comprehended in this variety.

The nature and colour of the hair seem closely con-

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nected with the complexion; and, therefore, although in describing the varieties we have briefly noticed the difference in its colour, it may be proper to add a few particulars on this subject. In proportion to the thinness of the skin, and the fairness of the complexion, the hair is soft, fine, and of a white colour: this observation holds good not only in the varieties which have been described, but also in the Albinos. Next to them in fairness of complexion is the Gothic race, the *rutilæ comæ* of whom were a distinguishing characteristic, even in the time of the Romans. The Celtic tribes are not so fair as the Gothic, and their hair is darker and more inclined to curl; so that the observation which Tacitus makes respecting the Silures still applies to them, *Colorati vultus, torti crines.* But though the colour of the hair is evidently connected with the complexion, yet its tendency to curl does not appear to be so. The brown complexioned Celts have curled hair; the Mongolian and American varieties, of a much darker complexion, have hair of a darker colour, but long and straight. Among that portion of the Malay variety, which inhabits the South Sea islands, soft and curled hair is frequently met with.

The hair of the New Caledonians is crisped; that of the negroes woolly. The difference between these has been accurately marked by Forster. "The hair of the negroes," he says, "is not only frizzled, but each particular hair is found to be extremely thin, and proceeding from a root remarkably smaller than that observed in other human hair." This thinness he attributes partly to climate, but principally to the copiousness of perspiration not being checked by the use of oil. "The inhabitants of Otaheite," &c. he adds, "never have woolly hair, because they prevent too copious perspiration by the application of oil." This opinion, however, does not seem to be well-founded, since Winterbottom asserts that the custom of anointing with oil is universal among the Africans. Forster's *Observations made during a Voyage round the World*, p. 239. *Winterbottom*, vol. i. p. 192.

Colour of the eye.

The colour of the eye is also connected with the complexion. In the Africans, Professor Soemmering remarks, that the *tunica adnata*, or white of the eye, is not so resplendently white as in Europeans; but rather of a yellowish brown, something similar to what occurs in the jaundice. The iris in the negroes, in general, is of a very dark colour; but, according to Pegafeltu, the iris in the Congo negro is frequently of a bluish tinge; and it is worthy of remark, that, according to this author, these negroes have not the thick lips of the Nubians. The Gothic tribes are not more distinguished by their fair complexion than by their blue eyes (*cærulei oculi*); while the iris of the darker coloured Fin, according to Linnæus, is brown, and that of the still darker Laplander, black. The colour of the eyes also follows, in a great degree, in its changes, the variations produced by age in the complexion. Blumenbach informs us, that newly born children in Germany have generally blue eyes and light hair, both of which become gradually of a darker hue, as the complexion of the individual grows darker; and Ligon, in his "*True and Exact History of Barbadoes*," p. 52. says, that the children of the negroes there, when they are born, "have the sight of their eyes of a bluish colour, not unlike the eyes of a young kitten, but as they grow older they become black."

Albinos.

The most singular race of men in point of complexion, are the Albinos. It is doubtful whether Pliny referred to them under the name Leucæthiopes, as he merely gives the name; but from the manner of the term, it is probable he did. Tellezius, quoted by Ludolphus, in his *Ethiopic History*, (lib. i. cap. 14.), is among the first of modern writers who notices them: he says they were not uncommon in Abyssinia, where they were regarded with abhorrence, and their complexion was attributed to disease. Dampier and Wafer seem next to have noticed them in the isthmus of Darien. Knox, in his account of Ceylon, describes the Bedahs there as a kind of Albinos; but subsequent information respecting this island, though it proves this race to be very different from the other inhabitants, by no means confirms the account of Knox. Argensola, in *l'Histoire de la Conquete des Isles Moluques*, vol. i. p. 148. describes some of the inhabitants of these islands as Albinos, being as fair as Germans, with very weak eyes; and some of the older accounts of Chili and Florida, which mention the blue-eyed *cessares* of the former country, and the *acansas* of the latter, if they can be depended upon, would seem to prove that Albinos once existed in these parts of America. But this singular race of men is most commonly met with in Africa; and the African Albino has been most minutely examined and described.

Hawkins, in his *Travels in the Interior of Africa*, p. 116, describes the hair of the Albinos as red, or rather ashes coloured, sometimes approaching to yellow; and though soft, still preserving the woolly appearance of the negro. "The pupil of their eyes," he says, "is white." In the colony of Sierra Leone, Winterbottom saw a girl about nine years old, who had been born in Nova Scotia; her parents belonged to the Nova Scotian blacks, who were afterwards sent to that part of Africa. She had all the features of the negro; her hair was woolly, the colour of a dirty white; her skin differed from that of most Albinos, for though it equalled in whiteness the skin of a European, yet it had not that disagreeable appearance and texture which distinguish this singular race of people. She also differed from the generality of them in possessing stronger eyes, though the colour of them was somewhat between a red and light hazel. The same author saw another girl, of nearly the same age, born of black parents; her skin was of an unpleasant dead-looking white, pretty smooth, but beginning to assume a cracked appearance: this character of the skin is more distinct in the Albinos as they grow up; it then becomes remarkably coarse and wrinkled, dry and harsh to the touch, and marked with deep furrows. In this state of the skin, it is very susceptible to the action of the sun, which not only cracks it, but sometimes even occasions it to bleed: it is also very susceptible to the bites of insects.

The eyes of the Albinos are always deprived, in a greater or less degree, of their colouring matter, as well as the rete mucosum; the iris is sometimes red, and sometimes of a reddish brown colour; the pupil has the same tinge, and also the edges of the *tarsi*. When they are exposed to a strong light, they are continually winking.* In some instances, the sebaceous

* The eyes of the Albinos are also said to be entirely destitute of the *uvea*, and to have only the choroid coat very thin, and tinged of a pale red by discoloured blood: as it is known that the interior of the eye, when the embryo is about five weeks old, is covered with a blackish mucus, it is highly probable that this never exists, or is entirely destroyed in the Albinos; and thus the numerous blood vessels which nearly compose the iris and pupil, appear distinctly and unmixed.

Complexion. Albinos.

glands are very large and numerous. Winterbottom says, that the singularities which distinguish this variety of the human species, exist previously to birth: they never change afterwards, and are in some cases hereditary. † At Wankapong, this writer saw a young man, about 18 years old, whose father had been a white negro; his mother, three brothers, and two of his sisters, were black, but one sister was white like himself. None of these people whom Winterbottom saw, seemed to labour under any imbecility of intellect; but their corporeal strength, and their power of enduring fatigue, was inferior to that of other negroes. The same observation is made by Dampier, in his account of the Albinos of the isthmus of Darien, who, from his description, resemble those of Africa very much in the colour of their skin, hair, and eyes.

It was for a long time supposed that Albinos were confined to the East Indies, Africa, and America; and from their being found there, nearly under the same latitude, Buffon adopted the opinion, that "white was the primitive colour of nature, which, in certain circumstances, after having been varied by climate, by food, and by manners, to yellow, brown, and black, returns, but so greatly altered, that it has little or no resemblance to the original whiteness." This opinion, however, is not well-founded. Albinos, with exactly the negro cast of countenance, and the peculiar appearance of the eye, have been found in various parts of Europe; though the singularity is not nearly so striking in a white as in a black person. Professor Blumenbach says, that he has seen sixteen individuals resembling Leucæthiopians, born in various parts of Germany; and M. Buzzi, (*Opuscoli Scelti de Milan*, 1784), mentions a woman in that city who was the mother of seven sons, three of whom were Albinos. In 1803, a man died in Herefordshire, who was a complete Albino: he was rather below the middle stature; his hair was white and soft, and his eyes red. He was one of six children, all the rest of whom were quite exempt from this singularity.

Change of complexion by intermarriage.

A middle complexion is produced where children are born from parents of different races. If the offspring of the darkest African and the fairest European intermarry successively with Europeans, in the fourth generation they become white; when the circumstances are reversed, the result is reversed also. Along with the successive changes of complexion, is also produced a change in the nature and colour of the hair; though, in some instances, the woolly hair remains when the complexion has become nearly as fair as that of brown people in Europe. With regard to the offspring of Europeans and American Indians, the hair, according to Humboldt, does not indicate a mixture of the Indian blood, so clearly and certainly as the thinness of the beard, the smallness of the hands and feet, and a certain obliquity of the eyes. This offspring, to which the name of Mestizo is given, are distinguished by a colour almost pure white, and a skin of a particular transparency. Ulloa describes, in a more minute and exact manner, the signs which indicate the Mestizos. The most remarkable, according to him, is the lowness of the forehead, which often leaves but a small space between their hair and eyebrows; while, at the same time, the hair grows remarkably forward on their temples, extending to the lower part of the ear. Besides, he adds, the hair itself is harsh, lank, coarse, and very black; their nose very small, thin, with a little rising on the middle, from whence it forms a small curve, terminating in a point, bending towards the upper lip. These marks, besides some dark spots on the body, are so constant and invariable, as to make it very difficult to conceal the fallacy of their complexion; when, as it sometimes happens, it is so fine that they might otherwise pass for whites. (*Ulloa*, vol. i. p. 276.)

It does not, however, always happen that the offspring is the intermediate colour between that of the respective races to which the father and mother belong; it sometimes resembles one parent only; while, perhaps, in the second or third generation, the colour of the other parent makes its appearance.

White, *On the regular Gradation of Man*, mentions a negress who had twins by an Englishman; one was perfectly black, its hair was short, woolly, and curled; the other was white, with hair resembling that of an European: and Parsons, in the *Philosophical Transactions*, gives an account of a black man who married an Englishwoman; the child, the offspring of this marriage, was quite black. The same author gives another instance, still more remarkable: A black in Gray's Inn married a white woman, who bore him a daughter, resembling the mother in features, and as fair in all respects, except that the right buttock and thigh were as black as the fathers. (*Philosoph. Trans.* vol. i. p. 45.)

On the influence of climate in producing the varieties of complexion.

IV. The generally received opinion concerning the varieties of complexion which are found in the different races of man throughout the globe, is, that they are caused entirely by the influence of climate. Respecting the primary colour of man, the supporters of this opinion are not agreed. Buffon, as we have already noticed, thought that the primary colour was white, which, by difference of climate, food, and manners, was changed into yellow, brown, and black, and which manifested a strong tendency to return, notwithstanding the influence of these circumstances, in the Albinos. Mitchell, on the other hand, maintains, that the primitive colour of man was a medium between black and white, "from which primitive colour the Europeans degenerated as much on the one hand as the Africans did on the other; the Asiatics (unless, perhaps, where mixed with the whiter Europeans), with most of the Americans, retaining the primitive and original complexion." *Philosoph. Trans. abridged by Martyn*, vol. x. p. 948.

But whatever sentiments the advocates for the influence of climate on the colour of man entertain respecting the original complexion of the human race, they are all agreed concerning the nature and process of that influence. They contend, that climate having altered, in a slight degree, the complexion of the primitive inhabitants of the earth, their offspring, still exposed to the influence of the same cause, and being born of the acquired colour of their parents, produced a generation still varying in a greater degree from the primitive complexion; thus assuming, that the complexion caused by climate is transmitted to the offspring, by which means

† The hereditary tendency to this singularity of complexion, like other hereditary tendencies, sometimes remains evident for one or more generations. Parsons, in the *Philosophical Transactions*, vol. iv. p. 45, &c. mentions the case of a Negro woman, married to a man of her own colour, who brought forth a white child: afraid of the anger or jealousy of her husband, she wished to have concealed it from him, but he was neither angry nor surprised: he said that white children had often been born in his family; his father was of that complexion, while his grandfather and grandmother were blacks.

Complexion.

all the varieties we have enumerated have been formed. This opinion has numerous and able supporters; among whom Buffon, Blumenbach, Zimmerman, Winterbottom, Mitchell, and particularly Smith, may be mentioned. *

A contrary opinion is held by Boyle, Kames, Pritchard, and a few other writers. † They do not deny the influence of climate on the human complexion; but they contend, that if the varieties of the human race are accurately examined and compared with the climate in which they respectively live, the opinion which they controvert, will be found directly opposed by a number of well-established and decisive facts. They also maintain, that the operation of climate on the human complexion differs in some very marked and important points, from what are known to exist in the complexions of the great varieties of mankind. As the opinion of these writers is liable to be misrepresented, it may be proper to add, that they even admit that climate may and does influence the complexion of all the races which are placed under the different varieties; so that the Malay, the Mongolian, and the Ethiopian variety, may be more or less black; but, at the same time, they contend, that though climate will account for shades of difference in the complexion of these races, it will not account for the radical and distinctive complexion itself.

The opinion that climate alone will account for the various complexions of mankind, is very plausible, and supported by the well-known facts, that in Europe the complexion grows darker as the climate becomes warmer; that the complexion of the French is darker than that of the Germans, while the natives of the south of France and Germany are darker than those of the north; that the Italians and Spaniards are darker than the French, and the natives of the south of Italy and Spain darker than those in the north. The complexion also of the people of Africa and the East Indies is brought forward in support of this opinion; and from these, and similar facts, the broad and general conclusion is drawn, that the complexion varies in darkness as the heat of the climate increases; and that, therefore, climate alone has produced this variety.

But if it can be shewn that the exceptions to this general rule are very numerous; that people of dark complexions are found in the coldest climates; people of fair complexions in warm climates; people of the same complexion throughout a great diversity of climate; and races differing materially in complexion among the same people, this opinion must fall to the ground.

Dark complexions found in cold climates.

1. In the coldest climates of Europe, Asia, and America, we find races of a very dark complexion. The Laplanders have short, black, coarse hair; their skins are swarthy, and the irides of their eyes are black. According to Crantz, the Greenlanders have small black eyes; their body is dark grey all over; their face brown, or olive; and their hair coal-black. (Crantz's *Hist. of Greenland*, i. 132.) The complexion of the Samoieds and the other tribes who inhabit the north of Asia, and of the Esquimaux, is very similar to that of the Laplanders and Greenlanders. Thus we perceive that a dark complexion, which, according to the advocates for the opinion which we are considering, is the result of a warm climate, is found among those people who live in the coldest parts of the habitable world. This fact is so glaringly and decisively against their hypothesis, that to account for it, they are obliged to call in the operation of other causes, and to contend that extreme cold, especially when connected with poverty and filth, will produce the same complexion as extreme heat; but besides the objection to this modification of their original hypothesis, that it is evidently had recourse to, in order to obviate a pressing difficulty, and is not borne out by a sufficient number of facts, there is another objection still more fatal and unanswerable. If we examine the inhabitants in the north of Europe, we find the Norwegians fair complexioned, blue eyed, and with flaxen hair; we pass on to the northern extremity of Norway, and without experiencing any sensible change in the coldness of the climate, we suddenly and abruptly meet with the swarthy skins, and the black hair and eyes of the Laplander. The operation of extreme cold, therefore, to produce this darkness of complexion, cannot be allowed; and the unaided operation of the other two alleged causes, poverty and filth, will hardly be deemed sufficient to produce such essential and permanent characteristics of complexion.

Laplanders. Greenlanders. Norwegians.

Zimmerman has justly remarked, that, in considering the question of the cause of the different varieties in the human complexion, we should pay no attention to mere geographical latitude; since climate depends upon so many other circumstances, besides the distance of the country from the equator. This observation ought to be kept in mind in considering the following facts, which still farther prove, that in a comparatively cold climate dark complexioned people are found. In the narrative of a route from Chunargur to Ragamundry, in the Ellore Sircar, by Mr Blunt, he met with several tribes of mountaineers, whom he describes as having dark skins, lips thick and prominent, with high cheek bones. Although the country which they inhabited is in the latitude of 23° 28′ N. yet the climate must be very cold, from the following circumstances: At Shawpoor, on the 11th of February, the frost was very severe, and the trees had lost all their foliage. Mr Blunt informs us, that he ascended more than 300 yards, in perpendicular height, after he left Shawpoor, before he arrived at the mountaineers whom he describes; and when he requested of them information respecting the climate of their country, they told him, that they never experienced any hot wind; on the contrary, the frequent rains throughout the year rendered the air so cool, that during the night a covering was necessary, (*Asiatic Annual Register* for 1800, *Miscellaneous Tracts*, pp. 136, 148, &c.) Thus we perceive, that, in a comparatively cold climate, the complexion and features of the inhabitants greatly resembled those of the warmer countries of this part of Asia.

Indians.

South American Indians.

Humboldt's observations on the South American Indians, illustrate and confirm the same fact. If climate rendered the complexion of such of these Indians as live under the torrid zone, in the warm and sheltered vallies, of a dark hue, it ought also to render, or preserve fair, the complexion of such as inhabit the mountainous part of that country; for certainly, in point of climate, there must be as much difference between the heat of the valleys and of the mountains in South Ame-

* Buffon's *Nat. Hist* translated by Smellie, vol. iii. pp. 57—207; Blumenbach *de Gener. Human Variet*; Zimmerman's *Geographical History of Man*; Winterbottom's *Sierra Leone*, vol. i. p. 188, &c.; Mitchell's Paper in the *Phil. Trans.* already referred to; Smith's *Essay on the Causes of the Variety of Complexion and Figure in the Human Species.*

† Boyle, in his *Experiments* already quoted; Kame's *Sketches*, book i. sket. 1; Pritchard *Disputatio inauguralis de Hom. Varietatibus.*

Complexion.

rica, as there is between the temperature of southern and northern Europe; and yet this author expressly assures us, "that the Indians of the torrid zone, who inhabit the most elevated plains of the Cordillera of the Andes, and those who, under the 45° of south latitude, live by fishing among the islands of the Archipelago of Chonos, have as coppery a complexion as those who, under a burning climate, cultivate bananas in the narrowest and deepest vallies of the equinoctial region." (*Political Essay on the Kingdom of New Spain*, i. 14, &c.) He adds, indeed, that the Indians of the mountains are clothed; but he never could observe, that those parts which were covered were less dark than those which were exposed to the air. The inhabitants, also, of Terra del Fuego, one of the coldest climates in the world, have dark complexions and hair.

Fair complexions found in hot climates.

2. Fair-complexioned races are found in hot climates. Ulloa informs us, that the heat of Guayaquil is greater than at Carthagena; and by experiment he ascertained the heat of the latter place to be greater than the heat of the hottest day at Paris; and yet in Guayaquil, "notwithstanding the heat of the climate, its natives are not tawny:" indeed, they are "so fresh coloured, and so finely featured, as justly to be styled the handsomest, both in the province of Quito, and even in all Peru." (*Ulloa*, i. 171.) "In the forests of Guiana, especially near the sources of the Orinoco, are several tribes of a whitish complexion, the Guiacas, the Guagaribs, and Arigues, of whom several robust individuals, exhibiting no symptom of the asthenical malady which characterises Albinos, have the appearance of true Mastigoes. Yet these tribes have never mingled with Europeans, and are surrounded with other tribes of a dark brown hue."* The inhabitants of Boroa, a tribe in the heart of Araucania, are white, and in their features and complexion very like Europeans.

South Americans.

Africans.

Even in Africa, darkness of complexion does not increase with the heat of the climate in all instances: the existence of comparatively fair races in this quarter of the globe is noticed by Ebn Hankal, an Arabian traveller of the tenth century, and has been confirmed by subsequent travellers. The following notices are from this author: In Bajeh, immediately bordering on the land of Abyssinia, is a race of people who have the same complexion as the Arabians. In Zingbar (Ethiopia) there is a race of white people, who bring from other places articles of food and clothing. But the most striking fact mentioned by this Arabian traveller, relates to a district which he calls Zouialah: This, he says, abounds in black slaves, but the inhabitants are of a brown complexion. In the eastern parts they are darker, and have light-coloured eyes; while some more remote have fair complexions, with blue eyes and reddish hair. One race of them has black eyes and black hair: These are said to be derived from the Arabs of the tribe of Ghirzaz. *The Oriental Geography of Ebn Hankal* translated by Sir William Ouseley, 1800, pp. 13, 14, 27.

Battal, an English traveller, observed, in south lat. 12°, a numerous camp of Negroes, of the Giagas or Gallas tribe, whom he describes as of a complexion much fairer than that of most other Negroes; and the complexion of the Foulahs, who live in 9° north latitude, is so fair, that some writers imagine them to be the Leucæthiopes of Ptolemy and Pliny. On the southwest, south, and south-east, Darfur, according to Browne, is bounded by two distinct races; one of which have woolly hair, and exhibit the true features of the Guinea Negro, while the other are of a reddish colour. The same author describes the people who inhabit the island near Assuan as black, but the people of the town are red coloured, like Nubians. The mountaineers of Harraza, and the inhabitants of Shulla, to the south of Darfur, are also red, (Browne's *Travels*, p. 165.) In some of these instances, the difference of complexion may have risen from the intermixture of races; but this observation will certainly not apply to all the cases. It may also be said, that there are two distinct races near Darfur, the Moors or Arabians, and Negroes, and that the fair complexion is entirely confined to the former. This observation will be considered, when we come to investigate the effects of a change of climate on the human complexion, when it will probably appear, that the difficulty in the way of the hypothesis we are combating is equally great, whether such marked differences of complexion are found among the aborigines, or among two distinct races, one of whom has been subjected for centuries to the operation of the same climate, which is said to have produced the darker complexion of the other.

The same complexion found in varieties of climate.

3. The same complexion is found over immense tracts of country, comprehending all possible varieties of climate. The most striking and decisive instance of this, is on the continent of America; all the inhabitants of which, with the exception of the Esquimaux, exhibit the copper-coloured skin, and the long and strait black hair. "Over a million and a half of square leagues," (observes Humboldt,) "from the Terra del Fuego Islands to the river St Lawrence and Beering's Straits, we are struck at the first glance with the general resemblance in the features of the inhabitants." (*Humboldt*, i. 144.) The same remark is made by Forster, who accompanied Captain Cook in one of his voyages round the world. (*Gottingen Magazin*, 1783, p. 929.) There are, no doubt, shades of difference in the complexions, and even some exceptions to the general remark, of a more decisive character: but these exceptions rather make against, than in favour of the opinion, that the colour of the Americans is the effect of climate. Several of them have been already noticed. But the grand fact is sufficiently conclusive, that under all the diversity of climates which the continent of America contains, there is either no radical difference of complexion, or that difference is the reverse of what climate ought to produce.

New Hollanders and New Zealanders.

New Holland and New Zealand are instances of a similar nature, though on a less extensive scale, over the whole of the former island; even in the very cold climate of the southern parts, the complexion of its inhabitants is of a deep black, and their hair is curled like that of negroes. New Zealand stretches from 34° to 47° south latitude, but its inhabitants do not vary in their colour; they are equally tawny under the extreme cold of 47° south, as under the milder climate of the northern parts of the island. The complexion of the inhabitants of the southern division of these islands, and

* *Humboldt*, i. 144. This author mentions other facts, which prove, that colour, at least that of the Americans, does not depend on climate. The people of the Rio Negro are swarthier than those of the Lower Orinoco, and yet the banks of the first of these rivers enjoy a much cooler climate than the more northern regions. The Mexicans are more swarthy than the Indians of Quito and New Granada, though the climate is exactly similar. "Under the 54° 10′ of north latitude, at Cloak Bay, in the midst of copper coloured Indians, with small long eyes, there is a tribe with large eyes, European features, and a skin less dark than that of our peasantry."

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also of those of Van Diemen's Island, which lies in 45° south, is another striking proof, that a dark hue does not depend on the heat of the climate.

Different complexions found under the same physical latitudes.

4. Different complexions are found under the same physical latitude, and among the same people. Illustrations and proofs of this have already been given. The physical latitude in which the Norwegians, the Icelanders, the Fins, and the Laplanders live, scarcely differs, and yet their complexions, and the colour of their eyes and hair, are widely different. There is a great diversity of colour and features among the Morlachi, who inhabit Dalmatia. The inhabitants of Kotar, and of the plains of Seigu, and Knin, have fair blue eyes, broad face, and flat nose. Those of Duare and Vergoraz, on the contrary, have dark coloured hair, their face is long, their complexion tawny, and their stature tall. (Fortis' *Travels in Dalmatia*, p. 51.) M. Sauchez, who travelled among the Tartars in the southern provinces of Russia, describes a nation called the Kabendedski, as having countenances as white and fresh as any in Europe, with large black eyes. (Smellie's *Philos. of Nat. Hist.* ii. p. 167.) The inhabitants in the neighbourhood of the Cape of Good Hope differ in their complexions much more than in the nature of the climate under which they respectively live. The Caffres are black; the Booshuanas of a bronze colour; and the Hottentots, a light brown, or brownish yellow. In the island of Madagascar, there are three races, distinctly marked. The first are black, with frizzled hair, supposed to be the original inhabitants of the island. The second race inhabit the interior provinces; they are tawny, and have long hair like the Malays. The third race reside near Fort Daupliris, and on the west coast; they are supposed to be descended from some shipwrecked Arabs, and retain a resemblance to that nation, (Sonnerat's *Voyages to the East Indies and China* translated from the French, iii. p. 30.) People with the Negro complexion and features, are also found in the interior of the Philippine islands; and in Java, the Hindoo and Malay character may be clearly traced in the complexion and features of the two classes of inhabitants which are found in that island. In several of the Moluccas, is a race of men who are blacker than the rest, with woolly hair, inhabiting the interior hilly parts of the country. The shores of these islands are peopled by another nation, whose individuals are swarthy, with curled long hair. In the interior hilly parts of Formosa, the inhabitants are brown, frizzled haired, and broad faced, while the Chinese occupy the shores. Forster observes, that there are two great varieties of people in the South Seas; the one more fair, the other blacker, with their hair just beginning to be woolly and crisp. The first race inhabits Otaheite, and the Society Isles, the Marquesas, the Friendly Isles, Easter Island, and New Zealand; the second race peoples New Caledonia, Tanna, and the New Hebrides, especially Mallicollo. If we examine the relative situation and latitudes of these islands on a map, we shall be convinced, not only that darker complexioned people are found where the climate is comparatively colder, but that the same complexion is found under very different latitudes.

Dalmatians.

Caffres and Hottentots.

As, in several instances which have been given, especially under the last head, the difference of complexion may be supposed to have arisen from difference of race, and therefore by no means to prove the point at issue, we shall now proceed to consider the effects which have been produced by change of climate, where the complexion has been exposed to the operation of this cause for several generations.

Changes in the complexion by change of climate.

It may, however, be proper to premise one general remark: It would by no means follow, even if it could be proved that the complexion of the Caucasian, or fair-skinned variety, had been permanently and radically changed by long exposure to a warm climate, that this change was the effect, solely, or principally, of climate; intermarriage will produce the change to the greatest degree in which it is alleged to have been produced. Whereas, if cases can be brought forward, in which the primitive complexion of the variety has resisted the operation of change of climate for a great number of generations, it may fairly be inferred, that native differences of colour do not depend upon climate; and that, as they are not changed by a change of climate, they were not originally occasioned by climate. The cases which have been already given, of people with radical varieties of complexion and features existing together in the Philippine islands, in Madagascar, &c. ought, perhaps, to have been referred to that division of the subject which we are now about to discuss; but as there is no historical evidence, (though there is strong presumptive proof,) that the people of either of these varieties emigrated from a different climate to their present abode, it was thought more methodical to consider their cases under the last head; but however they are arranged, their bearing on the point at issue is equally direct and strong.

Complexion of the Colchi.

1. The case of the Colchi shall be first considered. Herodotus informs us, that, in his time, they were distinguished by the blackness of their complexion, and the crispature of their hair; and that, from these circumstances, the Egyptians regarded them as the descendants of part of the troops of Sesostris. This case is regarded by the advocates for the opinion that climate produces and changes complexion, as making very decidedly and strongly in their favour; no such people are now found in those regions, as Herodotus describes the Colchi to have been; therefore, they argue, that the blackness of their complexion, and the crispature of their hair, must have been destroyed by the influence of climate. The application of the general remark with which we introduced this part of our subject, would be a sufficient answer to this argument; since, during the course of 2000 years, intermarriages, and other causes by no means connected with climate, may fairly be supposed to have produced those changes which are attributed to climate. But the case of the Colchi, when properly considered, makes against, instead of for, the influence of climate: As, however, this view of the case cannot be put in its strongest light, unless we previously ascertain what were the complexion and features of the Egyptians (from whom the Colchi were supposed to be descended) in the time of Herodotus, a few observations must be premised on this point.

Complexion of the primitive Egyptians.

Volney maintains, that the primitive Egyptians were negroes. This opinion he draws from the present appearance of the Copts—from the features of the sphynx—and from the appearance of the mummies. Browne decidedly controverts this opinion: The Copts, he says, have no resemblance of the Negro features or form: Their complexion is a dusky brown, like that of the Arabs. But the argument drawn from the Copts, is of little value on either side of the question; for though they have intermixed less than most people with their conquerors, they cannot be regarded as pure. The an-

Complexion of the primitive Egyptians.

cient mummies, paintings, and statues, Browne adds, bear a strong resemblance to the modern Copts. This part of their argument will be afterwards considered: At present, we shall confine ourselves to this author's interpretation of the passage of Herodotus respecting the Colchi. The terms which the historian applies to the Colchi, μελαγχροες και ουλοτριχες, (Herodotus *Euterpe*, § 104.) Browne contends, are merely relative: "in the vernacular idioms of modern Europe, by the term a black man, is daily designated one of visibly darker complexion than ourselves." It is presumed, that this observation is contradicted by every person's experience, and therefore need not detain us; it is of more importance to seek for the real meaning of the terms used by Herodotus. If they do not designate the black complexion and crisped hair of the Negroes, it would be difficult to find terms in the Greek language to describe them. A few passages from other Greek authors will shew in what sense they are used: Strabo calls the Ethiopians μελανας και ουλοτριχας; and Aristobulus, who is quoted by this author, speaking of the Indians, says, they are not ουλοτριχας. Diodorus Siculus, describing the Ethiopians on the banks of the Nile, says they are μελανας, snub-nosed, τοις δε τριχωμασιν ουλοι; and, not to multiply instances in so plain a case, Aristotle, in his *Problems*, expressly asks, how it happens, that men ουλοτριχες are for the most part σιμωτεροι, (*Strabo*, lib. xv. p. 799. *Basil*, 1571. *Diodorus Siculus*, lib. iii. p. 103. Aristot. *Problem.* § 33. ques. 18.) We may therefore conclude, that the description given by Herodotus of the Colchi, designates men of black complexions and crisp hair; and that, in his time, the Egyptians were such.

The argument from the mummies, respecting the complexion and features of the primitive Egyptians, has been illustrated with great knowledge and acuteness by Professor Blumenbach: From an examination and comparison of different mummies, and of the artificial monuments found in Egypt, he infers, that there were three principal varieties in the national physiognomy of the ancient Egyptians; the Ethiopian cast; the one approaching to the Hindoo; and the mixed, partaking in a manner of both the former, (*Observations on some Egyptian Mummies*, Phil. Trans. for 1794.) The testimony of ancient historians, at least so far as regards the first two varieties, bears out the inference of Blumenbach. Besides the passage in Herodotus, we have the direct testimony of Diodorus Siculus, that the Ethiopians inhabited the islands in the Nile, and that they considered the Egyptians as one of their colonies. Subsequent historians represent the complexion of the Egyptians as less dark than it was in the time of Herodotus. Ammianus Marcellinus thus describes them: "Homines autem Egyptii plerique *subfusci* sunt et atrati," (*Ammian. Marcell.* lib. xxii. cap. 16.) From not adverting to the difference of the era of Herodotus and this author, Browne considers this passage as in favour of his opinion, that the Greek historian meant to describe the Colchi, as merely black and crisp haired in comparison with the Greeks; but, in the course of eight centuries, which had elapsed between the two authors, the intermixture of Persians, Greeks, and Romans, must have reduced the blackness of the Egyptians, as much as the difference between the terms used by them designates. The term which Ammianus Marcellinus applies to the Egyptians in a subsequent passage, "erubescunt," as it is applied to their moral character, and must therefore be taken in a figurative sense, is improperly considered by Browne as any proof of the truth of his opinion. But even before the time of Ammianus Marcellinus, the complexion of the Egyptians seems to have lost the darkness of the Ethiopian, and to have approached to the second variety mentioned by Blumenbach, viz. that of the Hindoo. Arrian describes the natives of the south of India as similar to the Ethiopians in the blackness of their complexion and hair, but without their crispature and form of nose; and he adds, the Indians who live nearer the north are liker the Egyptians. *

We may therefore conclude, that, though subsequently to the time of Herodotus, the complexion of the Egyptians had become less dark, and their hair less crisp. Yet in his time they greatly resembled the negroes in these respects; and consequently that the Colchi, whom he describes as resembling the Egyptians, and whom tradition represented as a colony from them, had black complexions and crisped hair. Let us now revert to the bearing of this fact on the question respecting the influence of climate.

In the first place, Herodotus expressly states, that the proof of the Egyptian descent of the Colchi, drawn from the complexion and hair, amounted to nothing, because there were other nations in that part of Asia with similar complexions and hair. From another passage in this historian we may infer, that this observation is to be taken in rather a qualified sense; by the expression "other nations," he evidently refers to the Eastern Ethiopians; but these he describes as differing from the Western or Libyan Ethiopians: his words are, "the Eastern Ethiopians have straight hair, those of Lybia have more crisped hair than that of all other men. (Lib. vii. § 70; and Lib. iii. §. 101.) It is however sufficiently evident from this historian, that people of such a dark complexion as to be called Eastern Ethiopians, inhabited that part of Asia, which was under the dominion of Darius the son of Hystaspes; and as there is no evidence that they were colonists, we must suppose they were the original inhabitants. The fact, therefore, of the non-existence now of a race of similar complexion and hair to the Colchi, is no proof of the influence of climate; since it cannot be maintained that the temperate climate, of which the Eastern Ethiopians were natives, would destroy the dark complexion of the Colchi. The testimony of Herodotus, therefore, to the existence of the Eastern Ethiopians in that part of Asia, must be considered as affording an additional proof, that there is no essential connection between radical and permanent darkness of complexion and extreme heat of climate; and the disappearance, both of the Eastern Ethiopians and the Colchi, must be ascribed to some other cause than the operation of climate.

In the second place, the Egyptian colony, from whom the Colchi were supposed to be descended, settled here in the time of Sesostris; that is, according to the most moderate computation, 1400 years before Christ: but Herodotus travelled for the purpose of collecting materials for his history about 440 years before Christ; so that the complexion of the Colchi had withstood the influence of the climate for nearly 1000 years; and if it withstood it so long, and the Colchi at the end of that period still retained the crispature of their hair, as well as the blackness of their complexion, we certainly are

* Arrian, *Ind.* p. 173. In his *Life of Alexander*, speaking of the Indians in general, he describes them as blacker than all men, except the Ethiopians.

justified in concluding, that the subsequent disappearance of these characteristics was owing not to the climate, but to other causes; but there are grounds for believing that the Egyptian characteristics of the Colchi continued unchanged long after the time of Herodotus. Bochart, in his *Sacred Geography*, cites passages from St Jerome and Sophronius, in which Colchis is called the second Ethiopia; and the last author, in his life of St Andrew, says that there were Ethiopians near the mouths of the Apsarus, and on the banks of the Phasis; that is, in the very country of the Colchi. (Bochart, *Geog. Sac.* lib. iv. cap. 31. p. 286.)

Black complexion extends farther north on the west side of Africa than on the east.

2. The black complexion extends much farther to the north, on the west side of Africa, than on the east: the inhabitants of Fezzan, in latitude 27° 48′ are black, whereas the Egyptians in the same latitude are brown or olive; on the east side of Africa, we must go to the latitude of 15° N. before we trace the line between the Arabs and the blacks. The Abyssinians are of a dark olive colour, with long hair; yet the adjoining people, and the people under the same latitude on the west side of Africa, are negroes. This difference of complexion and hair in the Abyssinians has generally been ascribed to their living under a more temperate climate than the negroes, though the latitude is the same; but their great resemblance to the Arabians, and the direct testimony of historians, proves that they are descended from that people; and, as Gibbon remarks, "the Arab cast of features and complexion which has continued 3400 years in the colony of Abyssinia, will justify the suspicion, that race as well as climate must have contributed to form the negroes of the adjacent and similar regions." (*Gibbon*, vii. 341.) If we trace the inhabitants of the east coast of Africa still farther to the south than Abyssinia, we shall detect, by their features and complexion, the Arabian conquerors; while the races, which they expelled, may be equally clearly traced in the districts into which they were compelled to remove. The difference between the Hottentots and Caffres has been already noticed:—the latter undoubtedly were originally natives of the warmer parts of Africa; and have been driven to the neighbourhood of the Cape by the pressure of the Arabians and other more powerful people. In the time of Vasco de Gama, about the end of the 15th century, the Caffres were found in Terra de Natal; and before that period they seem to have inhabited the coasts of Africa still farther to the north. (*Ancient Accounts of India and China by two Mahommedan Travellers* translated by Renaudot, p. 162—164.

3. Procopius mentions a race of people far within the desert of Lybia, not black-skinned like the Moors, but of very fair bodies and yellow hair: these have generally been supposed to be descendants of the Vandals; but had they been so, Procopius, who lived soon after the passage of the Vandals from Spain into Africa, would probably have mentioned their origin. Whatever, however, was the origin, or the time of their settlement, they were found by Dr Shaw, in the very spot where Procopius places them, on the mountains of Auress, with their yellow hair and their fair and ruddy complexion. (Procop. *Bell. Vand.* xi. c. 13. Shaw's *Travels*, p. 120.

4. Herodotus fixes the boundaries of the Libyans and Ethiopians near the Niger, about Cassona; and nearly the same line may yet be drawn in this part of Africa, between the fairer and darker complexioned natives. The Arabians, under the name of Moors, entered this part of Africa about the seventh century; and though in many places separated from the negroes, merely by the Senegal, and in other places inhabiting the very same regions, they are still distinct in complexion and features.

Complexion of the Huns.

5. The description which ancient writers give us of the Huns, evidently proves that they belonged to the Mongolian variety. Their original seat was an extensive tract of country, immediately on the north side of the great wall of China. About one hundred years after Christ, they emigrated in two great divisions, one of which settled in the fruitful plains of Sogdiana, on the eastern side of the Caspian. This division obtained the name of the *white* Huns, from the change in their complexions. This change Gibbon is disposed to attribute to the mildness of the climate in which they took up their abode; but as their emigration was from a colder to a comparatively warm climate, the change in their complexion and features must be ascribed rather to their intermixture with the inhabitants of the country in which they settled, probably with the Greeks of Sogdiana. †

Complexion of the inhabitants of the Andaman Isles.

6. Colonel Symes, in his embassy to Ava, landed on the Andaman Islands. The natives he describes as "a degenerate race of Negroes, with woolly hair, flat noses, and thick lips; their eyes are small and red, and their skins of a deep soot black." From this description it is evident that they resemble the natives of the interior parts of the Philippine islands; and we should have noticed the fact under a former head, had there not been proof of their unchanged complexion and features for nine centuries. The Mahommedan travellers of the ninth century, whose account has been published by Renaudot, describe the inhabitants of Andaman exactly as Colonel Symes does; "their complexion is black, their hair frizzled:" so that they not only differ radically from the inhabitants of the adjacent islands of Nicobar and the continent, but have undergone no alteration in this long period of time. (Symes' *Embassy to Ava*, p. 7. 4to. edit. *Asiatic Researches*, iv. 385. Renaudot, p. 4.)

Complexion of the Gipseys.

7. That singular race of people, the Gipseys, made their appearance in Hungary and Bohemia, according to Grellman, about the year 1417; and reached as far west as England, about a century afterwards. This author is of opinion that they came originally from the East Indies. Wherever they are found in Europe, they exhibit the same complexion, and colour of eyes and hair; nor, in the course of four centuries, do they appear to have lost, in the smallest degree, their original and primitive colour. (Grellman, *Hist. Versuch ueber die Liegenner.*) The same remark may be applied to the Jews; wherever they have preserved themselves unmixed, they exhibit a striking uniformity of complexion and features, in all the various coumtries of Asia, Africa, and Europe, in which they are found.

Complexion of the Dutch at the Cape of Good Hope.

8. Foster remarks, that "the Dutch who have been settled at the Cape of Good Hope, during an uninterrupted course of 120 years, have constantly remained fair, and similar to Europeans in every respect, though many of the Boors live almost in the same manner as their neighbours the Hottentots." (Foster's *Observations*, p. 271, 272.) And Chapman, in a narrative of a voyage to Cochinchina, informs us, that the aborigmes

† It is probable that the Mantchoo Tartars of China, who are represented as having fair and florid complexions, light blue eyes, and brown hair, are descended from the white Huns.

Complexion. Cochinchinese.

of this country, are called Mags, and inhabit the chain which separates it from Cambodia. They resemble the Caffres in features and complexion, whereas the present possessors, who came in the 15th century, retain the complexion and features of the Chinese, from whom they are sprung. (*Asiatic Annual Register for* 1801.) In the West Indies and America, Europeans and Negroes were introduced nearly about the same time; but they each retain their radical and permanent characteristics of features and complexion.

Complexion of the Goths, Celts, and Slavi.

9. Pinkerton, in his *Dissertation on the Goths and Scythians*, has proved, that the original inhabitants of Europe were Celts; that the Goths, coming from Asia, pressed there towards the west; and that the Slavi succeeded the Goths, and occupied the eastern parts of this quarter of the world. Each of these races was distinguished by peculiarity of features, complexion, and colour of eyes and hair, which they still retain in a greater degree than might have been expected, considering their intermixture: the *colorati vultus*,* and *torti crines* of the Celts, are much more common among their descendants, the Welsh, and the native Irish, than among the Gothic or Slavonic tribes. The characteristics of the Gothic race are frequently and strongly marked by the ancient historians; to the Germans, the epithets of *cœrulea lumina*, and *Flava cæsaries* are applied by Juvenal, (xiii. 164.) and *cœrulei oculi*, and *rutilæ coma*, by Tacitus; (German. iv.) and Manilius speaks of *flava Germania*, (Astron. lib. iv.) The Gauls, most of whom were a Gothic race, have applied to them, by Livy, the epithet *rutilatæ comæ*, (xxxviii. 16.) Virgil also describes their yellow hair, *aurea cæsaries*, (viii. 659.) and fair complexion, *lactea colla*, (Ib. 660.) and, in the time of Ammianus Marcellinus, they were distinguished by the same characteristics, *candidi pene Galli sunt omnes et rutili*, (lib. xvi. § 1. See also *Diod. Siculus* lib. v. Edit. Stephan, p. 212. and *Strabo*, lib. vii. p. 290, Edit. Caus.) The inhabitants of South Britain are described by Strabo as resembling the Gauls in complexion and eyes, but with hair less yellow; and the passage of Tacitus is well known, in which he infers the German origin of the Caledonians, on account of their *rutilæ comæ*, (*Strabo*, lib. iv. p. 194. Tacit. *Afric.* § 11.) The characteristic complexion, hair, and eyes, of the Goths, are still very evident in the Norwegians, Danes, and Icelanders, who have intermingled least with other tribes.† Forster is of opinion, that the blue eyes and red hair of the Gothic nations of Europe, are to be ascribed to the circumstances of their being "the most early inhabitants of the north, and therefore of their having had more time to become gradually fairer, than the greater part of their neighbouring European tribes;" (Forster, 273.) but this remark is not well founded; we have seen that blue eyes and red hair were characteristic of the Gauls, Germans, and Britons, in the time of the Romans; and they were also characteristic of other Gothic tribes in much more southern latitudes. About 270 years before Christ, a tribe of German Gauls founded the kingdom of Galatia in Asia Minor, and it is this tribe to whom Livy, in the passage already quoted, applies the epithet *rutilatæ comæ*. The description of the *Alani*, given by Ammianus Marcellinus, is a still more decisive proof that the fair complexion and flaxen hair of the Goths, are not attributable to the influence of a northern climate, but distinguished them in their native southern country. The Alani inhabited the plains between the Volga and the Tanais; and Ammianus Marcellinus says, they were almost all tall and fair, with hair inclining to yellow; Gibbon, indeed, ascribes the fairness of their complexion and hair to the mixture of Sarmatic and German blood; but we have the express testimony of Ammianus, Nicophorus Gregoras, and Xiphilin, that the Massagetæ and the Alani were the same people, and the Massagetæ were undoubtedly a pure Gothic tribe.‡

The Slavi, who came last into Europe, were distinguished by a brownish complexion, dark eyes, black or brown hair, and, in general, red bushy beards; and these marks they retain in the different climates of Poland, Bohemia, Russia, and Dalmatia.

Thus we perceive that the distinguishing complexions, hair and eyes, of the Celts, Goths, and Slavi, are, at the present time, nearly as well marked as they were in the time of the Romans, and that a change of climate has not essentially altered them. In traversing Europe, we pass from the Celtic tribes to the Gothic, and from the Gothic to the Slavoni, without experiencing any change of climate; and we find the comparatively dark-complexioned Celts and Slavi, in the Highlands of Scotland, and in the latitude of Petersburgh, while the blue-eyed, and comparatively fair-haired Goths, are found in the south of Germany. §

As, therefore, the dark-complexioned varieties of mankind are found near the Poles;—as people of the same complexion are found over the whole continent of America, under all its various climates; as there are numerous instances of comparative fairness of complexion under the heat of a burning climate; as radical differences of complexion are found in the same regions, and even among the same people; and as there are numerous instances where the original complexion has remained permanent, notwithstanding it has been exposed to a change of climate for centuries, it may fairly be inferred that the characteristic complexions of the different varieties of the human race are not the result of climate.

* That *colorati* means dark-complexion is evident from this epithet being applied by Virgil to the Ethiopians, (iv. 239. and to the Indians. Albinoranus also applies it to the latter, *coloratos postquam devicimus Indos*.—Eleg. xi. line 57.

† Volney says, travellers who go from Normandy to Denmark are struck with the resemblance between the natives of the two countries.

‡ Ammian. Marcell. xxxi. 2. Gibbon, iv. 373. Nicephorus Gregoras, lib. vi. *de alanis*; and Xiphinus in Hadriano. Pliny also reckons the Alani among the Scythic or Gothic nations.—Lib. iv. cap. 12. From the description which this author and Solinus, (who indeed is a mere abridger of Pliny,) gives of the Albani of Asiatic Scythia, Pinkerton infers that they were also a Gothic tribe, but as they are described as having *white* hair from their youth, reddish eyes, (*glauca oculorum acie, a pueritia statim canos*,) and as seeing better by night than by day, they were probably a species of Albinos. Besides, Pliny only says, there were some such people in Albania, not that all the inhabitants were of this description.—Pliny, *Nat. Hist.* lib. vii. cap. 2.

§ This general remark must be taken as liable to many exceptions, as, in every country in Europe, the intermixture of races has been very great and influential; but it is substantially true, that the Celtic, Gothic, and Slavonic races may still easily be recognized, and distinguished in Europe, whether they inhabit the warmer or colder latitudes: that climate will not account for the difference of their complexion since some of each tribe are found nearly in the same climate, and the extreme variation of climate in no case is great, and since before they settled in their present climates, they had the same distinguishing characteristics of complexion, hair and eyes, as they now possess.

Complexion. Difference between native and acquired complexion.

It is not meant to be denied that a burning climate will not render the complexion very dark; and that a climate of less extreme heat will not *bronze* the complexion of the fairest European; but there are some material points, in which the dark complexion of the Caucasian, or naturally fair-skinned variety of mankind, caused by climate, differs from the dark complexion of all the other varieties of the human race.

1. The offspring of the Caucasian variety is born fair;—the offspring of the other varieties is born of the respective complexion of their parents. Ulloa informs us, that the children born in Guayaquil of Spanish parents are very fair. (*Ulloa*, i. 171.) The same is the case in the West Indies. Long, in his History of Jamaica, expressly affirms, "That the children born in England have not, in general, lovelier or more transparent skins, than the offspring of white parents in Jamaica." But it may be urged, that this is not the case with respect to the other nations of the Caucasian variety, who have been settled in warm climates from time immemorial; and that the question ought to be decided by the Moors, Arabians, &c. Their children, however, are also born fair complexioned; as fair as the children of Europeans, who live under a cold climate. Russell informs us, that the inhabitants of the country round Aleppo are naturally of a fair complexion; and that women of condition, with proper care, preserve their fair complexion to the last. (Russell's *Aleppo*, i. 99.) The children of the Moors, according to Shaw, have the finest complexions of any nation whatsoever; and the testimony of Poiret is directly to the same effect: "The Moors are not naturally black, but are born fair; and when not exposed to the heat of the sun, remain fair during their lives. *Shaw*, p. 304; and Poiret's *Voyage en Barbarie*, i. 31.

Respecting the complexion of the Negro and Indian children, when first born, there appears to be some difference of opinion; but this difference will be found on examination to be of little moment, and to have arisen from some authors speaking of their complexion at the very moment of their birth, while others describe it, as appearing a few days afterwards. In fact, *all children*, immediately when born, have a reddish hue; and the children of Negroes and Indians resembling the children of Europeans in this respect, it has been inferred that they were born white. We should, therefore, endeavour to ascertain the complexion of Negro and Indian children, after the reddish hue is gone off, and before they could possibly be affected by the heat of the climate. Winterbottom informs us, that Negro children are nearly as fair as Europeans at their birth, and do not acquire their colour till *several days* have elapsed." (*Winterbottom*, i. 189.) And Ligon, in a passage in his account of Barbadoes already quoted, mentions that, when first born, the palms of their hands, and soles of their feet, are of a whitish colour. (*Ligon*, p. 52.) A friend of Mr Boyle's, who kept between 300 and 400 Negro slaves in the West Indies, informed him, that their children were of a reddish colour when born, like Europeans, but in a *few days* became black. (Boyle's *Works abridged by Shaw*, ii. 42.) And Andrew Pattell (whose travels are given in Purchas) says, that the children in Longo are born white, and change in *two days*. The dark complexion first appears round the nails, the nipples, and the private parts.

Humboldt affirms, that in Peru, Quito, on the coast of Caraccas, the banks of the Orinoco, and in Mexico, the children of Indians are never born white; but Gumilla, in a passage quoted by the translator of Humboldt, expressly asserts, that the Indian children, at their birth, are white, except a small spot on the waist; but in a few days acquire their natural colour. It is probable, that Humboldt speaks of them, not immediately on their birth, but when they had acquired this colour. (*Humboldt*, i. 146.) As, therefore, there seems no doubt of the fact, that the children of Negroes and Indians, whatever may be their colour immediately on their birth, become in *a very few days* of a dark colour, it may be regarded as a fair and indubitable inference, that this change is not produced by the climate. Those, indeed, who contend, that the children of Negroes are naturally fair, and acquire their dark complexion solely by the influence of the climate, wish to make out a case against their own hypothesis; for if climate could, in a very few years, or even months, render the fair born children of Negroes like their parents, the children of Europeans, born in Africa or the West Indies, should become equally black when they grow up; and we should not now be able to distinguish any difference between the Europeans and the Negroes in those countries. Besides, if this opinion were true, the fair born children of Negroes in Europe ought to continue fair during their lives, since the alleged cause of a change of complexion, a burning climate, did not exist.

2. Individuals belonging to the Caucasian variety that inhabit warm countries, preserve their native fairness of complexion, if they are not exposed to the influence of the climate; while there is a uniform black colour over all the parts of a negro's body. The women of Circassia, Arabia and Aleppo, and the Moorish women, we are informed by travellers, are very fair, not being exposed to the influence of the sun. (Russel and Poiret, in the passages already quoted; *Observations de Pierre Belon*, p. 199; *Voyage fait par ordre du Roi, dans la Palestine*, quoted by Buffon, and other authorities given by him, iii. 12.) On the contrary, every part of the body of a Negro or Indian is equally black. Soemmering asserts, that the cavity of the axilla, the inside of the thigh, and the *glans penis* are black; and even a small circle of the *conjunctiva* round the cornea is blackish, while the rest of the membrane has a yellowish brown tinge. Humboldt affirms, that "the Indian Caciques, who enjoy a certain degree of ease in their circumstances, and who remain clothed in the interior of their houses, have all the parts of their body (with the exception of the hollow of their hand and the sole of their foot) of the same brownish red, or coppery colour." And, in another place, he says, that "the Indians of the mountains (whom we have already noticed, as having as coppery a complexion as those in the vallies) are clothed;" and yet he never could observe, "that, in the same individual, those parts of the body, which were covered, were less dark, than those in contact with a warm and humid air." (*Humboldt*, i. 145. and 146.) Winterbottom makes the same remark respecting the Negroes, which Humboldt does respecting the Indians: "that the palms of their hands and the soles of their feet, are nearly as white as in Europeans, and continue so through life." (*Winterbottom*, i. 189.) This probably arises from the greater thickness of the cuticle in those parts, and is an argument against that membrane being the seat of colour in the dark-complexioned races.

But for the illustration of these points, it is not necessary to refer to the Negroes and Indians, as contrasted with the Caucasian race under a warm climate; in our own country, there are people naturally of a dark complexion, and people who are merely rendered

Difference between native and acquired complexion.

dark by the influence of the sun. The children of the former (if the parents are both dark-complexioned) assume the colour of their parents very soon after they are born (let them be ever so carefully protected from the sun); whereas, the children of parents merely tanned continue fair, if not exposed to the sun. The skin of persons in this country, naturally dark-complexioned, is nearly of the same colour all over their bodies; but the skin of tanned persons preserves its natural fairness in those parts which have not been exposed to the sun. The coldness of winter, or removal into a cold climate, has no visible or permanent effect on the complexion of people of this country, who are naturally dark; whereas, a dark complexion, merely acquired by exposure to the sun, even in the East or West Indies, is removed entirely, or in a great degree, by a cold climate. Indeed, the notorious fact, that in this and other northern countries of Europe, there are families of a naturally dark complexion, and families naturally fair skinned, but extremely liable to be tanned, proves that climate cannot be the sole cause of dark complexion; while the facts which we have stated, respecting the colour of the children of the Caucasian and other varieties, and respecting the different complexion of the Caucasian variety, according as the body is exposed to the sun, or kept covered, and the uniform colour of the Negro and Indian, illustrated as they are by what occurs among ourselves, clearly points out in what respects native complexion differs from acquired.

There are several other circumstances which point out the difference between native and acquired complexion, and which prove that the colour of the dark-complexioned varieties is not the effect of climate;—but on these we can merely touch.

The hue which Europeans assume is the same, though the tinge may be lighter, or darker, whether they settle in Africa, the East Indies, or South America. They do not become, like the natives of those countries, black, olive coloured, or copper coloured; their complexion merely resembles that of a tanned person in this country, only of a darker tinge. The Negroes that are settled in the West Indies, or America, do not assume the copper colour of the Indians, even though a milder climate may have some effect on the darkness of their complexions.

The children of Europeans, of Negroes, and of Indians, are all born in America of the same reddish hue; but in a few days, those of the Negro begin to assume the black complexion of their parents, those of the Indian the copper complexion, while those of the European either continue fair, if kept from the influence of the sun, or become tanned; not black like the Negro, or copper coloured like the Indian, if exposed to its influence.

Europeans who settle in Canada, or in the northern parts of America, where the climate resembles that of their native country, do not assume the complexion of the Indians, but continue fair like their ancestors. The same observation may be made respecting the Russians who are settled among the Mongolian variety, in those parts of the Russian empire in Asia, the climate of which resembles the middle or northern parts of European Russia. Indeed, the wide extent of country over which the Mongolian variety is spread, including the extreme cold of Lapland and the north of Asia, the mild temperature of the middle parts of that continent, and the warmth of the southern parts of China, is in itself a proof, that dark complexion does not arise either from the influence of heat or cold.

Lastly, Radical varieties of complexion are always accompanied with radical varieties of features. We do not find the olive colour of the Mongolian variety with the features of the Malay; nor the brown colour of the Malay with the features of the Mongolian; nor the black skin of the Ethiopian variety, or the red colour of the American, united with any set of features but those which characterise their respective varieties.

It, however, by no means follows, that the hypothesis of different races having been originally formed, must be adopted, because climate has been proved not adequate to the production of the radical varieties of complexion which are found among mankind. The conclusions which Dr Pritchard (*Dissert. Inaug. de Hom. Variet.* p. 119.) draws, are much more philosophical and consonant to all the facts which have been brought forward in this article.

1. That the natural constitution of man, as well as of animals, is modified by climate, manners, and other physical and moral causes.

2. That the effects thus produced are confined to one generation, and not transmitted to the offspring.

3. That man, as well as animals, has a propensity to form natural varieties; and that the diversities of mankind are proofs and examples of this propensity.

Lastly, That as this propensity will account for all the varieties of complexion and features found in the human race, it is unnecessary and unphilosophical to have recourse to the hypothesis of different species originally created, to account for the phenomenon. (W. S.)

COMPOSITE Ratios, in Music, are such as are multiples, or their terms are similar powers of some other ratio, as has been explained under our article Commensurable *Intervals.* Other ratios, forming by far the greater part of the whole number of musical ratios, are called prime ratios, and their corresponding intervals prime or incommensurable intervals: respecting which last it is proper to observe, that the *numbers* composing such prime ratios or prime intervals, are not *prime numbers,* except in a very few cases, but are most generally composite numbers, involving the primes 2, 3, and 5, in almost every form of combination. (ϱ)

COMPOSITION. See Criticism, Music, Painting, and Rhetoric.

COMPOST. See Agriculture.

COMPOSTELLA, or St Jago de Compostella, the *Brigantium* of the ancients, a city of Spain, and the capital of Gallicia, is situated on a hill upon the banks of the little river Soria. The streets are handsome but ill paved, and the largest of the four squares is tolerably elegant. The cathedral is a fine Gothic building, and has its interior fitted up with peculiar magnificence. It contains 23 chapels, of which that of St James is lighted only from the cupola, which is very lofty. It is adorned with the statue of St James made of massive gold, and two feet high. The front of the altar, belonging to the chapel of the relics, and the frame-work above it and the tabernacle, are all of massive silver; but the shrines for the relics are made of silver, gilt and adorned with a profusion of diamonds, precious stones, and pearls, and resting by silver supporters upon small slabs. On the right and left of the altar are two columns which support a canopy, the whole of which is covered with plates of silver. A thousand wax candles are lighted here every night; the effect of which is inexpressibly magnificent. The treasury of this ca-

Compound Stops.

thedral is very rich. The hospital for the reception of poor pilgrims is well endowed, and consists of two long square courts, surrounded with piazzas of freestone, supported by solid freestone pillars, and in the middle are beautiful fountains constantly playing.

The other ecclesiastical buildings are large and imposing; but the most interesting of them is the convent of St Martin, which is remarkable for its library, its cloister, and its regular architecture, which is of the Doric order. There are four parish churches in the town, and eight in the suburbs, besides six convents. There is also an university founded in 1522, four colleges, four hospitals, and an elegant asylum for young orphans. There are eight large mercantile houses in Compostella, which carry on a considerable trade. There is here a manufactory of silk stockings, three hat manufactories, one of paper, and three tan-yards. Compostella is the seat of an archbishop, and the principal place of residence of the famous order of the knights of St James, who possess 87 commanderies, and a revenue of upwards of 200,000 ducats of gold. The revenue of the archbishopric is about £25,000. Population 11,900. (π)

COMPOUND STOPS, in Music, is a term for those sets of ranges of pipes on an organ, whose notes are made to sound at the same time, by touching a single finger-key. Or, compound stops are such, wherein each finger-key acts upon two, three, four, or even five pipes of different pitches, and causes them all to sound together. The most common of these stops in our church organs are, the CORNET, the SESQUIALTER, and the MIXTURE, or furniture stops: (See those several articles.) These compound stops, when used in full pieces, with other stops that are not pitched or tuned to the actual note which they represent, in the diapason stop, (which is considered as a sort of standard,) but to the xiith, or xviith of such notes, (see LARIGOT, TIERCE, and TWELFTH stops), cannot fail of introducing a great number of actual discords even into the common chord, besides beating concords in plenty, with the notes of other finger-keys, as any one might readily satisfy himself, by writing down the values of the several notes thus sounded together, or even their artificial commas would be sufficient, taken from the first range, or Σ's, in the last column of Plate XXX. Vol. II.; or, these several notes might all be deliberately sounded together in succession, or in different pairs, on the single simple stop of an organ with an extended scale, like that of Mr Liston. From a series of experiments on such an instrument, when truly tuned, the reason might perhaps be discovered why the ear can tolerate such a mixture and jargon of discordant sounds as a full chord on an organ with compound stops presents; and whether it is merely by disregarding the discords, as it does any extraneous noise during a concert, as some have supposed. (ϱ)

COMPOUND CONCORDS, in Music, are such as are compounded of any two of the CONCORDANT *Elements*, (see that article,) or the simple or three least concords, 3rd, III. and 4th, or any of those again with one or more octaves, whether they form *original*, *doubled*, *tripled*, &c. concords; thus 3rd + III = V, 3rd + 4th = 6th, and III + 4th = VI; 3d + VIII = X, III + 2 VIII, &c.; V + VIII = XII, 6th + 2 VIII, &c. are all compound concords. (ϱ)

COMPOUND INTERVALS, in Music. Many writers, from contemplating some one of the many ways in which a particular interval may be compounded of, and consequently resolvable into, other smaller ones, have introduced this term, but which is in reality not a distinction, since every interval whatever may be *compounded* of one, two, or three others, by addition, addition and subtraction, or double subtraction. If one interval is successively added to form another, such should be called *double*, *triple*, *quadruple*, of that interval; as examples of the above, the double fourth or 7th = 24th; $\mathrm{T} = \mathrm{t} + \mathrm{c}$, $\mathrm{T} = \mathrm{t} + \mathrm{€} + \Sigma$, $\mathrm{T} = \mathfrak{S} + \mathrm{P} - \Sigma$, and $\mathrm{T} = \mathbb{T} - \mathrm{€} - \Sigma$, &c. ($\varrho$)

Comptonia || Conception.

COMPTONIA, a genus of plants of the class Monœcia, and order Triandria. See BOTANY, p. 322.

CONANTHERA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 194.

CONCEPTION, in pneumatology, is thus defined by Mr Stewart: "By conception I mean that power of the mind, which enables it to form a notion of an absent object of perception, or of a sensation which it has formerly felt." (*Elem. of the Philosophy of the Human Mind*, p. 132.) Again he says, p. 134, "The business of conception, according to the account I have given of it, is to present us with an exact transcript of what we have felt or perceived." According to this view of the subject, we ought to say, when we see an object with our eyes open, that we have a *perception* of it; when we shut our eyes, we have a *conception* of it.

We have no objection to this use of the word *conception*; but we are strongly inclined to suspect that it ought only to be considered as a modification of another faculty of the mind, and not as a distinct and original principle. In as far as conception relates to objects, or feelings which have already been presented to the mind, we cannot perceive in what it differs from the memory of past sensations, or perceptions. We should be glad to know the difference between a distinct *recollection* of past feelings or occurrences, and the conception of them. The object of memory is to store up in the mind the impressions which we have already received, and to bring them forth for use, as circumstances may require. When we have a distinct recollection of what we saw and felt yesterday, we may, in popular language, be said to have a clear conception, idea, or impression of it. But in all this we can see nothing but an ordinary exercise of memory: and we suspect that philosophers have created this new faculty of *conception* out of a figurative expression, which implies, at bottom, nothing more than a particular exercise of memory.

Mr Stewart confesses that conception is often confounded with memory. When a painter, for instance, makes a picture of an absent friend, he is said to paint from memory. But then it is said, "every act of memory includes an idea of the past; conception implies no idea of time whatever." *Philosophy of the Hum. Mind*, *ubi supra*. We apprehend there is no good reason for this distinction. The memory leaves out all idea of time, when it is conversant about mere relations, which are general, and have no reference to time. When the objects presented to our observation are of a singular nature, and such as rarely occur, time becomes an important accessary, and is recorded with a particularity corresponding to the rarity or supposed importance of the things. Hence when any thing remarkable occurs in the course of our lives, we commonly say, that we shall never forget the *time*. But nobody thinks of taking any account of time in considering those relations, which are treasured up in the memory, when they are of such a kind as occur every day, and fall in with the usual course of nature. In the same manner, when our thoughts are directed towards feelings or events necessarily connected with the *past*, and of such a nature that we are led to wish or fear their recurrence, in that case, *time* necessarily enters into our conceptions. But in thinking on the general laws of nature, and their various connections and relations, we never once think of *time*, though a moment's reflection would convince us that we are running over ideas which have already been presented to the mind.

Mr Stewart makes this distinction between conception and memory, that the former enables us to make our past sensations and perceptions, objects of thought; the latter recognises them as exact resemblances of what has been already felt or perceived. We confess that, in this instance, we cannot see the slightest grounds for a distinction. Does not every act of memory enable us to make our past sensations, or perceptions, objects of thought at the very moment that it recognises them as old acquaintances? Is it possible to recollect any thing without having an *idea* of it? We take the word *idea*, in this sense, to be perfectly synonymous with conception; and we maintain that no other power but that of recollection, or some modification of memory, is necessary to give us the idea, or conception of past sensations or perceptions. A man *remembers* that he was hurt, that he felt pain, that he had a leg amputated, that he was long in recovering; in all this, what use is there for the interposition of any other power than memory to recal the idea of his misfortune?

Conception is often confounded with imagination. Mr Stewart has very properly stated the distinction: he considers imagination to be that power which enables us to combine the parts of different conceptions, so as to form new wholes of our own creation. According to our view of the subject, the distinction is still more obvious. Conception, according to Mr Stewart, presents to the mind ideas already familiar to it; which we consider to be merely an act of memory, whose object is to give a faithful copy of the past, and which, in its simple exercise, is wholly uninfluenced by the will. Imagination, on the contrary, is memory, under the controul of the will, which, not satisfied with following the order prescribed by nature, or suggested by accident, selects the parts of different conceptions or objects of memory, to form a whole, more pleasing, more terrible, or more awful, than has ever been presented by nature. When we wish to represent the terrible, we seldom find in one object all the circumstances necessary to produce the full effect. We therefore bring together all the circumstances of terror *which our memories can recollect*, and we can conceive no other, in order to deepen the horror and heighten the effect.

We are aware that imagination is considered to depend chiefly on the association of ideas. But we are disposed to contend that even this *associating principle*, to which such wonderful effects are ascribed, has no claim whatever to be reckoned an original power of the mind. We conceive it to be also a modification of memory: and if it should be asked, how the recollection of one event suggests all its relations, and produces an unceasing flow of connected ideas, we answer, that it is merely the memory recording what has been presented to the mind, and running over that connected order, which has been exhibited in the course of nature, or in casual or artificial arrangements. Every event, and every object, is either the natural or the artificial sign of something connected with it; and memory may be called the recorded history of these relations. It places before the mind what has been felt or perceived; and it is as natural for it to recollect the order, and other circumstances under which objects were presented, as it is to recollect the objects themselves. And if we consider how almost infinite these relations may become, from time, or place, or circumstances, or feelings, we may easily conceive how the memory may expatiate over this boundless field, "and find no end in wandering mazes lost."

From the statement which we have given, it will appear, that we consider the ultimate principles of our nature as much fewer than have usually been represented: and we fear it is a proof of the little progress which has lately been made in the philosophy of mind, that whilst those facts in physical science, which were formerly considered as ultimate, are daily diminishing in number, in consequence of the extension of knowledge; an opposite process has taken place in the science of mind; and philosophers have shown a disposition to multiply, unnecessarily, the original principles of our nature. Every science is improved by the simplification of its principles; and this is an improvement which has not as yet been introduced into pneumatology.

The observations which have been made on this subject, are chiefly applicable to Mr Stewart's view of conception, which he represents as an exact transcript of past sensations or perceptions. But the term is used in a much more extensive sense by Dr Reid, who considers it as necessary in every operation of the mind. "It may be observed," says he, "that conception enters, as an ingredient, in every operation of the mind: our senses cannot give us the belief of any object without giving some conception of it at the same time." *Intell. Powers*, p. 358. So, then, to see an object with our eyes, or to handle it with our hands, is not sufficient to give us an idea of it: this mysterious power of conception must interpose, to introduce to the mind the ideas communicated through the organs of sense. The senses are the doors by which the visitors are admitted; conception is the gentleman usher who introduces them to the presence. Are we then to consider conception as the connecting link between the senses and the mind? We must first see the shadow of a proof in support of such an opinion. The senses are quite sufficient to do their own office; though the imperfection of philosophy has been woefully exposed in attempting to explain the manner in which they accomplish their end.

Conception, considered as an original power of the mind, must mean the power of forming conceptions, notions, or ideas. Dr Reid himself confesses, that these words are used synonymously, *Intellect. Powers*, chap. 1. On the same principle, then, we might say, that the power of forming ideas, is an original power of the mind. But it is perfectly evident, that some of our ideas may be traced to one simple faculty, whilst others result from the combined operation of different powers: and is not this the true origin of our conceptions, taking the word in the extensive sense in which Dr Reid employs it? They can be traced to simple powers of the mind, or to their combinations: and whatever idea, or conception, arises from the exercise of one or more of our faculties, is, *ipso facto*, presented to the mind, without requiring the intervention of any power distinct from those in which it originates.

It has been assumed as a maxim in philosophy, that *whatever we can conceive is possible*: but this has been strenuously contested by Dr Reid, *Intellect. Powers*, p. 400. According to Mr Stewart's doctrine on conception, however, the proposition is self-evident. If it gives us an exact transcript of what we have perceived or felt, then, whatever we can conceive is possible; for its possibility has been demonstrated by its having al-

Conception.

ready been an object of our perceptions or sensations. And even taking conception in its most extensive signification, as the power which gives us the knowledge of every combination which the mind can form, we apprehend that even in this sense whatever we can conceive is possible. In the most extravagant workings of the imagination, though the combinations may be new, yet they are all composed of old materials, and though the images may be incongruous, they are not contradictory; however absurd, therefore, they may be, yet they are not impossible. The meaning of the proposition, contested by Dr Reid, evidently is, that *whatever we can conceive to be possible, is possible.* This explanation would obviate his objection, drawn from the *Reductio ad absurdum,* in mathematical propositions; in which, he says, we are required to conceive things that are impossible, in order to prove them to be so. We can conceive *what is meant* when it is affirmed, that three and three make seven, but we cannot for a moment conceive it to be possible. But then, says Dr Reid, what one man judges to be possible, another judges to be impossible; the maxim therefore in this sense cannot be true. But whenever two men are found to differ respecting the possibility or impossibility of any proposition, fact, conception, &c. it will probably be found that their conceptions are both correct, *according to the view which they have taken of the subject.* From limited views, or false principles, a man may conceive a very obvious truth to be impossible: according to his conception of the subject, he is perfectly right: it cannot be possible, on the principles which he has assumed: but remove his prejudices, and correct the errors of his judgment, and then his conceptions will keep pace with the enlargement of his knowledge, and he will see the truth of what he before conceived to be impossible.

We have ventured, in this article, to call in question the opinions of some eminent philosophers, whose abilities we highly respect, and whose labours we duly appreciate. They have done much more, indeed, than could have been reasonably expected, in the infancy of pneumatology: their ingenious observations, and valuable facts, must facilitate the investigations of future enquirers: and much certainly yet remains to be done. We conceive the science of pneumatology to be, at present, much in the same state in which chemistry was, in the days of the alchymists, when false but ingenious theories stimulated enquiry, and evolved facts, which a more accurate method of philosophizing has reduced to the regularity of science. (*g*)

CONCEPTION, Concepcion, or Penco, is the chief city of Chili, in South America, and principal place of a province and corregiomento of the same name, was founded by Pedro de Valdivia, in the year 1550. The old city was situated on a gentle declivity, at the mouth of the river St Pierre, and its houses and public buildings, with the exception of the college of the Jesuits, were equally mean and insignificant. In the year 1751, it was completely destroyed by an earthquake, and the greater part of it swallowed up by the sea. About three leagues from the old town, and a quarter of a league from the river Biobio, a spot was chosen, in 1763, for the scite of the new city. In order to guard against the effects of earthquakes, the town was built so as to occupy a great extent of ground, and the houses were erected only of one story. Owing to the low state of commerce, the houses of the most wealthy inhabitants are destitute of furniture, and almost all the artificers in the town are foreigners. The harbour of Conception, which is in the form of a horse shoe, and which is called by the Spaniards Herradura, is five leagues from the town, with which it communicates by means of light vessels by the river Andaliers. The town of Conception carries on a considerable trade with Peru, by means of ten or twelve vessels, and the principal articles of commerce are hides, tallow, dried beef, and wheat, besides the flour and biscuit which it furnishes to French vessels on their way to Peru. In return for these it receives from Lima, tobacco, sugar, and some articles of European manufacture. The inhabitants also carry on a considerable trade with the Puelches, a savage and independent tribe, who inhabit the Cordilleras. The quantity of gold annually found in the diocese of Conception is valued at 200,000 piastres. Population, 13,000. West Long. 73° 4′ 45″, and South Lat. 36° 49′ 10″.

Conception, Concert Pitch.

For a fuller account of this town, and the bay of Conception, see Ulloa's *Voyage to South America,* vol. ii. chap. v. vi. p. 234, Eng. edit. 1807; La Perouse's *Voyage round the World,* vol. i.; Alcedo's *Geograph. Dictionary,* vol. i. p. 500.; and the article Chili, vol. vi. p. 194. (τ)

CONCEPTION. See Midwifery.

CONCERT Pitch, in Music, is that particular pitch, or degree of acuteness, of the several notes which is used in the best concerts of this period. This *pitch* is entirely a matter of convention, or agreement, among musicians, there being nothing in the nature of sounds that can fix or determine the pitch of any particular note of the scale; nevertheless, any one of these being assumed or given, the principles of harmonics, and rules of tuning thence derived, will enable the practical musician, or tuner, therefrom to derive all the other notes of the scale.

With singers, where no instrumental accompaniments are used, it is common to use a Pitch-Pipe, almost similar to a stopped organ pipe, having the handle of its piston, or plug, graduated, or marked with the distances to which it should be drawn out, to sound each of the twelve half notes in the scale, or more, if wanted; and, before beginning any piece of music, the pipe is set to the key-note of the tune, or piece, and sounded. This is called pitching the tune, anthem, glee, &c.

Performers on stringed instruments, as violins, violoncellos, &c. commonly (when there is no organ or piano forte present) use a Tuning-Fork for pitching the note A, (because they have no string for C,) but tuners of keyed-instruments, harps, &c. and some singers, use a C tuning-fork, this being the note which is considered as the fundamental key-note, or lowest of the twelve notes in the scale. The particular C (among its various octaves) that is generally sounded by large tuning-forks, is that on which the tenor-cliff is placed, called the tenor-cliff C, and answers to a leger line above the bass stave, and the same below the treble stave, in written or printed music: it is C-*sol-fa-ut* of the Guidonian gamut, $\bar{c}$ of the German tablature, and C of the middle septave, according to Earl Stanhope.

The most modern musical writers seem agreed, that the present *pitch* of the last-mentioned note is such, that it excites 240 complete or double vibrations in the air, that is, backwards and forwards, in one second of time, at or near a mean state of the barometer at 30 inches, and the thermometer at 60°, the latter in particular; and all the various tables of beats of tempered systems, which have been published in the *Philosophical Magazine* by Mr Farey and Mr Smyth, and those which will be given in our work, under the names of the inventors of the systems, &c. are adapted to this pitch of the tenor-cliff C, and will only apply to instruments of that pitch.

In our article ACOUSTICS, vol. i. p. 115, we have given a simple and useful theorem, that may also be thus expressed, viz. $N = \left(\sqrt{\frac{96.5t}{w}} \div L\right)$, for finding the number of complete vibrations made by any note in one second of time; which we shall here illustrate, by the calculation of an example at length, by logarithms, so arranged, as to serve as a *formula* for all similar operations, of an experiment that we once made on a C tuning-fork, or rather, on the vibrations of a brass-wire tuned unison therewith, the wire taken from a coil, of which (58.4 inches in length weighed .0073 lb. avoirdupois) 1 inch weighed .000125 lb. (w) One end, of a sufficient length, of this wire was fixed to the top peg of a vertical monochord, or SONOMETER, hanging over a pretty sharp steel edge below the peg, and to the other end of this wire a sort of scale-dish, for receiving weights (decimals of the lb. of 7000 grains) was attached; and a 10 lb. weight being placed in the scale-dish, another moveable steel bridge on the monochord was set, and fixed so, that when, by tilting the monochord a little, or, rather, bringing it nearer to a vertical position than it before hung, by means of a strong hinge by which it was attached at the top to its frame and stand, this lower bridge cut off or limited such a part of the wire between it and the upper bridge, as gave a sound when struck, something lower than the fork under experiment. Other smaller weights were then added in the scale-dish, until the sound of this portion of the wire, 11.7 inches long (L) between the bridges, exactly agreed with the fork. The weights in the scale-dish, the weight of that dish and its apparatus, and the weight of the remaining length of the wire over and above 11.7 inches, being calculated, as above, and added together, gave 10.34 lb., extremely near (t), for the stretching weights; whence we have

Constant logarithm (of 96.5 inches)	= 1.9845273
Logarithm of the stretching weight (t), = 10.34 lb. . . .	= 1.0145205
	2.9990478
Logarithm of weight of an inch of the wire (w), = .000125 lb.	= 6.0969100
	2)6.9021378
	3.4510689
Logarithm of the length of vibrating wire (L), = 17.7 inches	= 1.0681859
Logarithm of the complete, or double vibrations, in 1″ (N) .	= 2.828830 = 241.48

Whence it appeared, that this tenor-cliff C fork gave 241.48, or very near $241\frac{1}{2}$ vibrations per 1″.

In calculating by this formula, it may be previously copied out, the lines being at proper distances, as above, ready to receive the numbers answering to t, w, and L, as they are determined in the course of the experiment; and it may not be amiss to observe respecting these, that *grains*, *ounces*, *grammes*, or any other weights, and their decimals, may be used, instead of pounds, provided t and w are both expressed in the same; and so *feet*, *lines*, *decimeters*, or any other measures, may be used instead of inches, provided the constant length, (96.5 inches, and its logarithm,) and the unit length of wire, as to the weight w, are both expressed in the same kind of measures. It can scarcely be necessary to subjoin, that the two first logarithms are added, the next subtracted from their sum, and the remainder halved, and from this the next is deducted, and the numbers answering to the remainder is taken from the Tables, as at the end. If it had been wished to reduce this fork to the proper standard of 240 vibrations, the apparatus remaining untouched for a few minutes, while the above calculations had been made. The following *formula* might, and may in all similar cases, be used for the necessary calculation of the proper, or corrected weight (t'), for such purpose, viz.

Constant logarithm (of 240^2) . . .	4.7604225
Logarithm of the former weight (t) = 10.34 lb.	1.0145205
	5.7749430
Logarithm of the former vibrations (N) = 241.48	2.3828812
	2
	4.7657624
Logarithm of the weight (t'), for 240 vibrations per 1″	1.0091806 = 10.214

Where the two first logarithms are added, the double of the third is deducted from their sum, and the number sought in the tables, that answers to this remainder. Whence it appears that 10.214 lb. ought to have been used, instead of 10.34 lb. to stretch the wire; and that the difference of these, or .126 lb. being taken out of the scale-dish, the wire would then sound the proper tenor-cliff C of *concert pitch*.

Then, a round file being provided, and the fork fixed in a vice, by slightly enlarging the size or depth of the bottom of the opening of the prongs of the fork, and repeatedly trying its sound with the wire, it might at length be brought to yield the proper number of 240 complete vibrations. If the fork had proved too flat, its pitch might be raised, by filing a small portion off the top of one or both of the prongs, so as to shorten them.

The above method, if repeated with care, and with different lengths of vibrating wire, and of weights, would very exactly adjust a tuning-fork, as exact, at least, as a *unison* could be judged of or adjusted by the ear, between the fork and the wire; and if, instead of trusting to this, a third sound from a wire or fork, a very little different from the unison intended to be adjusted, be provided, and the *beats* of the fork and wire, with this comparative sound, be made *equal* in a second or any other period, as Mr W. Nicholson recommends in his *Phil. Jour.* 8vo. i. p. 320, every desirable degree of accuracy may be obtained by this method, in the pitch of a 240 fork, as such might be called and marked.

If a fork or a pipe or major comma higher were wanted for tuning *organs* of Mr Liston's construction, as Mr Farey has shewn to be necessary, in the *Phil. Mag.* vol. xxxix. p. 420, the same must be adjusted to 243 vibrations for C′, and should be so marked: and if for Mr Loeschman's proposed enharmonic or perfect *piano* *forte*, (see *Phil. Mag.* xxxix. p. 423.) the forks should be adjusted to 237.032 for C'.

In the tuning of organs and piano-fortes by *tables of beats*, it will be improper to trust to a tuning-fork, or even to a standard pipe, perhaps, for adjusting C for tempered scales; but the second, third, or fourth of the methods laid down by Dr Robert Smith, in his *Harmonics*, 2d edit. p. 195, or his fifth method, p. 220. should some one or more of them be repeated, and the pipe slightly altered each time, if necessary, in order to bring it exactly to the proper pitch of C, or of C', according as may be wanted.

On euharmonic organs of Mr Liston's construction, there are a number of concords that are ready tuned, a comma sharpened or flattened, then after being re-tuned or examined, may be conveniently used in Dr Smith's second method: so those which are a schisma sharpened or flattened on such instruments, stand ready for proving the truth of the pitch, by counting the beats of such schisma-imperfect concords, and comparing them with a calculation previously made (see our article BEATS,) of the proper number per 1″, or any other period, as Mr Farey has shewn with respect to C E' ※; which fourth should beat 1.0836 times per second. See *Phil. Mag.* vol. xxxvii. p. 278.

The same gentleman has also derived a ready method of reducing an organ-pipe to 240 vibrations, by those who are furnished with a pocket-watch that beats or ticks 5 in a second, or 10 half-ticks, as those for experimental purposes always should be made to do, from considering the equal-beating system proposed some years ago by Earl Stanhope, (see STANHOPE's *Temperaments*,) viz. Tune the notes C, A ♭ and C, in the octave *below* the tenor-cliff C (CC being a true octave) such, that the minor sixth C A ♭ may beat *flat* 10 in a second, or agree exactly with the half-ticks of the watch, and then try the major third above, A ♭ C, and if this also agrees, but beats *sharp*, exactly with the ticks of the watch, the upper C vibrates just 240 times per 1″, as it should do. If the third beats ※ faster than the watch, the C's must each be lowered, until, by repeating the operation, they are found to agree; and the reverse, if it beats slower than the watch. With C, A ♭, and *f*, when C *f* is a perfect 11th, C A ♭ beats 10 ♭, and A ♭ *f* 10 ※: with C, E, and A ♭, when C E is perfect, C A ♭ is 10 ♭, and E A ♭ is 10 ※.

The complete table of the beats in the octave *above* the tenor-cliff C (240), in the system above mentioned, shews other *whole numbers* of beats *in a second* they may also be useful, with 10-beat, or with other watches; which beats, therefore, it may be right to set down here, viz. with C, E ♭, and G, when C G is perfect, or without beats, C E ♭ beats 15 *flat*, and E ♭ G beats 15 *sharp*; with C, E ♭, and C, C E ♭ is 15 , and E C is 15 ※; with C, E ♭, and B, when C B=V+III perfect (by help of G between them), C E , is 15 ♭, and E ♭ B is 30 ♭; with C, A ♭, and B, (C B as before) C A ♭ is 20 ♭, and A ♭ B is 30 ※; with C, A ♭, and *e*, when C *e* is a perfect Xth, CA ♭ is 20 ♭, and A ♭ *e* is 40 ♭; with C, E, D ♭, and *e*, when CE is a perfect III, and E *e* an octave, ED ♭ is 20 ♭, and D ♭ *e* is 20 ♭; with C, E ♭, B, and *e* ♭, when CB is V+III perfect, and CE ♭ is 15 ♭, E ♭ B is 30 ♭, and B *e* ♭ is 30 ※, then E ♭ *e* ♭ is a a true octave; with C, F, A ♭ and *f*, when CF is perfect, FA ♭ is 20 ♭, and A ♭ *f* is 20 ※, then F and *f* is a true VIII: and lastly, with C, A ♭, B, and *a* ♭, when CA ♭ is 20 ♭, A ♭ B is 30 ♭, and B *a* ♭ is 30 ※, then CB is V+III, and A ♭ *a* ♭ is VIII, both perfect; which many curious definite proportions between the beats (to the pitch 240) are of far more importance to the tuner, than any thing else belonging to this irregular douzeave, which Mr Farey has calculated, from his lordship's suggestions; and among them, proportions will be found, either in this or the inferior octaves, (where these beat only half as fast in succession as we descend,) that will watch the ticks of many watches, the same as those with 10 or 20 beats per second do a 10-beat watch, as above shewn: and it can scarcely happen with any watch, if the number of its beats or ticks in a second be calculated to decimals, when necessary, that the same, or some number of beats sufficiently near, and properly related as complements of VIII. or some other *perfect* interval,) will not be found, by a search into the several tables of beats that have been published, and if not, such can easily be contrived and calculated, by which the isochronism of the watch and the beats may be applied to examining, and in the most ready way correcting, the *pitch* of an organ. After, however, this mode has been applied, it will be right, if great accuracy is required, to try one of Dr Smith's methods above referred to, by way of check on the pitch. (*g*)

CONCHIUM, a genus of plants of the class Tetrandria, and order Monogynia. See HAKEA, BOTANY, p. 129.

CONCHOID. See CURVES.

CONCHOLOGY.

efinition. CONCHOLOGY is that branch of natural history which treats of shells, distributes them into genera and species, and describes the character and economy of the animals which inhabit them.

nportance of the ience vindicated. To some, the examination of this department of science has appeared useless, and unworthy to occupy the time and talent of an informed mind. Reasoning, with persons of this description, is seldom attended with any good effect. Ignorant of the advantages which have resulted to mankind, from an intimate acquaintance with natural objects, they overlook the steps by which they have been gained: and likewise seem to forget, that the examination of those objects, which an all-perfect Being has created, can never be degrading to man, who was sent into this world in order to examine, admire, and adore.

Besides, if we attend to the variety of forms which shells exhibit, and to the richness of their colouring, we will not be surprised that they have obtained a conspicuous place in public collections, and have attracted the notice of the curious observer. But to view shells merely as objects of beauty, without attending to the animals of which they form only a part, would be to overlook by far the most important branch of the science; and, like the florist, to take notice of colour and shape, and neglect to attend to those functions which, while they excite our astonishment, exhibit marks of design. The examination of the contained inhabitants, enlarges our knowledge of the laws of animal life, and teaches us that each shell, however insignificant it may seem to be, possesses faculties suited to the supply of its wants, and to the situation which it is destined to occupy.

History.

But we are not disposed to rest the claims of the science of conchology to public favour, altogether on the grounds which we have now stated. As objects of utility to man, shells deserve our notice. Many species supply his table with agreeable and nutritious dishes; others form most enticing baits for catching fish, or furnish materials for the manufacture of different kinds of dress. The pearl is prized as an ornament, and the Tyrian purple is deservedly held in estimation.

We must view shells likewise as the enemies of man, and entitled to his consideration. Some are deleterious to his constitution, while others defeat his plans. The Bernacle, by adhering to the bottom of ships, impedes their motion; and the Teredo pierces their planks, and destroys them.

When these circumstances are duly considered, the science of conchology will appear of importance, as it unfolds the history of objects of beauty, curiosity, and utility.

HISTORY OF CONCHOLOGY.

Ancients acquainted with conchology.

Of late years, the study of conchology has been pursued with eagerness by the most eminent naturalists. Under their auspices, the science has assumed a consistent and regular form. But let us not overlook the labours of the ancients. They may justly claim the merit of having first directed the mind to this subject, and we add to their praise, for having sketched the outlines of the plan, which has since been so successfully followed. In the enlightened ages of Greece and Rome natural history flourished, and the study of testaceous bodies occupied the attention of the man of science, and afforded recreation to the politician.

Aristotle, A. C. N. 322.

Aristotle flourished 322 years before the birth of Christ. His writings are precious monuments of his wisdom, and justly entitle him to rank as the father of natural history. He is the first who presented the world with a system of conchology. The outlines of his plan have been copied by succeeding conchologists. To him we are indebted for the orders, *univalves*, and *bivalves*. He likewise added a third order, in which he included the *turbinated shells*. Several of his genera are still retained, such as *Solen, Pinna, Nerita*, and *Pecten*. We grant, that he was acquainted with but few species, and that he even admitted as such many of the *opercula* of univalves; but when we consider the period during which he flourished, and the isolated nature of his labours, and compare these with the information in natural history which he possessed, we are astonished at his sagacity and wisdom.

Pliny, A. D. 80.

Pliny lived in times more favourable for the cultivation of science. The extensive shores of the Roman empire, the Mediterranean, and the Red Sea, presented a fine field to the enterprising conchologist. With all these advantages, little improvement was made by him in the science. His knowledge of species was more extensive than that of Aristotle, but his arrangement is unphilosophical, and his descriptions are unsatisfactory. To him, however, belonged some merit as a conchologist. He paid considerable attention to the form and external aspect of shells, in which he has been imitated by succeeding conchologists.

We must now pass over the dark ages which succeeded Roman greatness, in which science was degraded and ignorance deified. And when we arrive at the conclusion of the fifteenth century, we find little to interest or instruct us. Vincentius, in the year 1494, published his *Speculum Naturæ*. In this work he treats of the *Murex*, the *Purpeura*, and the *Ostrea*, but makes no attempt at arrangement. He borrows freely from his predecessors, Aristotle and Pliny, and supplies most liberally, from his own stores, notices of the superstitious absurdities of his day.

Vincentius, 1494.

Passing from the fifteenth to the sixteenth century, the conchological labours of three authors principally claim our notice. We here refer to the writings of Belon, Rondeletius, and Gesner. Belon, so famous for his travels in the East, and who was among the first of the learned men who travelled with the view of promoting science, published, in the year 1553, at Paris, an octavo volume, entitled, "*De Aquatilibus.*" To his descriptions of shells, he added a few tolerably faithful wooden representations.

Belon, 1553.

Two years after the work of Belon had made its appearance, Rondeletius, professor of physic at Montpelier, presented the world with his *Universa Aquatilium Historia*. His residence on the sea-coast afforded him an opportunity of examining the shells of the Mediterranean, an opportunity of which he seems to have availed himself. He has described and figured upwards of an hundred testacea.

Rondeletius, 1555.

Conrad Gesner, in the year 1558, published his work, *De Piscium et Aquatilium Animantium Historia*. Intimately acquainted with the knowledge of the ancients, and the observations of his immediate predecessors, Gesner, in this work, communicated much valuable information. His descriptions, in general, are ample, and his figures, though rude, are tolerably correct in the outline. He added several new species from the Indian and Arabian seas. To the threefold division of shells proposed by Aristotle, Gesner added a fourth, which he termed Anomola. Into this class he placed his genera of *Balani, Penicellæ marinæ, Tubuli marini*, and in company with these several crustaceous and molluscous animals.

Gesner, 1558.

During the seventeenth century, the science of conchology received many important additions. Johnston, in the year 1657, published his *Historia Naturalis de Exsanquinibus*. He employs in this work the classification of Aristotle, but divides the class *Turbinata* into two sections. The first section, *In Anfractum Torta*, includes the *Nautilus, Buccinum Murex;* and the second, *In Orbem Circumacta*, contains the *Trochi Neritæ*, and a few others.

Johnston, 1657.

In 1616, Fabius Columna published his *Aquatilium et Terrestrium aliquot Animalium aliarumque Naturalium rerum Observationes*. This work contains descriptions of several rare shells, with neat engravings. An edition of this work was published in 1675, by John Daniel Major, M. D. This naturalist, in imitation of Gesner, separated the genera *Lepas* and *Balanus* from the bivalves, and constituted them into a class by themselves, to which he gave the name of *Plurvalvia*.

Major, 1675.

Nehemiah Grew, in the year 1681, published his catalogue and description of the natural and artificial rarities belonging to the Royal Society of London, and preserved in Gresham College. We introduce this work, not so much with the view of mentioning that it was the earliest production of the kind which had appeared in an English dress, as of noticing the classification which he employed. To the divisions of shells termed univalves and bivalves, he added the class *Multivalves*, which Gesner had aimed at, and which Major had formed.

Grew, 1681.

We close our account of the testaceological writings of the seventeenth century, with noticing the labours of our countryman Lister, a name deservedly held in high estimation by all the lovers of science. Lister con-

Lister, 1685.

History.

menced his great work on shells in 1685, which he called *Historia sive synopsis methodica Conchyliorum.* The plates which accompanied this edition were 1057 in number, and contained precise descriptions of the shells, with a reference to the place from whence the specimens were brought. The plates vary in number and situation in other editions of this work, and appear to have been changed repeatedly by the author. The plates themselves were afterwards bequeathed to the University of Oxford, where they were republished, under the inspection of the Rev. William Huddesford. This gentleman added two *indices,* the one connected with Lister's own distribution, and the other with the Linnæan arrangement.

Lister distributed testaceous bodies as follows:

Lib. I. *De cochleis terrestribus.*

Pars. 1. De Buccinis et turbinibus terrestribus.

Lib. II. *De turbinibus et bivalvibus aquæ dulcis.*

Pars. 1. De turbinibus.

Pars. 2. De bivalvibus et fluviatilibus.

Lib. III. *De testaceis bivalvibus marinis, et conchis anatiferis.*

Pars. 1. De testaceis bivalvibus, imparibus testis.

Pars. 2. De testaceis bivalvibus, paribus testis.

Pars. 3. De testaceis multivalvibus.

Lib. IV. *De buccinis marinis, quibus etiam vermiculi dentalia et patellæ, numerantur.*

We conclude this account of Lister's labours, by stating, that he received the greatest assistance from his two daughters, Susannah and Ann Lister. To them was committed the charge of delineating and engraving the various objects; a task for which they appear to have been fully qualified, and whose names, say two eminent conchologists, " deserve to descend to posterity with their father's, and whose truly meritorious industry and ingenuity are patterns for their sex."

During the eighteenth century, the works which appeared on conchology were numerous and valuable. Collections of objects in natural history began to be formed on the continent, and in Britain, and vast sums were expended in bringing together the productions of nature. Naturalists were thus enabled to take more comprehensive views of objects, and to make more accurate arrangements.

Langius, 1722.

In the year 1722, Langius presented to the public a new system of conchology. To him we are indebted for having founded the distinctions of the genera on the aperture of univalves, and the hinge in bivalves. We shall here give the outlines of his system.

Pars. I. *Testacea Marina univalvia non turbinata.*

Classis 1. Testacea marina univalvia non turbinata, et in se non contorta.

Classis 2. Testacea marina univalvia, non turbinata, sed ita in se contorta, ut eorum spiræ non promeneant.

Pars. II. *Cochleæ marinæ, seu testacea marina univalvia turbinata.*

Classis 1. Cochleæ marinæ longæ, seu cochleæ marinæ ore admodum elongato et superius aperto.

Classis 2. Cochleæ canaliculatæ seu cochleæ marinæ ore elongato et superius in canaliculum abeunte.

Classis 3. Buccina seu cochleæ marinæ ore et mucrone simul elongatis primaque spira notabiliter ventricosa.

Classis 4. Strombi, seu cochleæ marinæ ore et mucrone simul insigniter elongatis, et prima spira notabiliter angustiore quam in buccinis.

Classis 5. Cochleæ marinæ ore admodum breve seu parvo, mucrone vero insigniter elongato.

Classis 6. Cochleæ marinæ breviores seu cochleæ marinæ ore et mucrone beviores, magisque contracto.

Pars. III. *Conchæ marinæ, id est testacea marina bivalvia quæ duabus constant valvis in cardine, articulatione quadam inter se conjunctis, ut commode claudi et aperiri queant.*

Classis 1. Conchæ æquilateræ, seu conchæ marinæ valvis equalibus ex utroque cardinis latere equalibus effusæ.

Classis 2. Conchæ inæquilateræ seu conchæ marinæ valvis equalibus ex utroque cardinis latere inæqualiter effusæ.

Classis 3. Conchæ anomolæ, seu conchæ marinæ valvis inæqualibus.

In perusing this system of Langius, it will be observed, that the author had bestowed considerable attention on testaceous bodies, and that he, in part, chalked out the course which Linnæus afterwards pursued.

In the year 1742, the splendid work of Gualteri made its appearance, containing 110 plates of shells. To this work Gualteri added a system of conchology composed by Tournefort, whose manuscripts, on this subject, had been presented to Gualteri, by Professor Targioni. This system exhibits the same force of intellect, the same penetration and discernment which characterise the other productions of that eminent naturalist. His generic characters are founded, in a great measure, on the structure of the hinge, and form of the mouth. His families are distinguished by a difference of shape. The old division of shells into univalves, bivalves, and multivalves, is retained, with this difference, that he gives the preference to the terms monotoma, ditomo, and polytomo. Shells in his system are thus arranged. Tournefort, 1742.

Classis I. Testacea Monotoma.

Familia 1. Testacea univalvia.
Fam. 2. Testacea spiralia.
Fam. 3. Testacea fistulosa.

Classis II. Testacea Ditoma.

Fam. 1. Testacea quæ arcte clauduntur.
Fam. 2. Testacea quæ semper hiant.

Classis III. Testacea Polytoma.

Fam. 1. Testacea quorum partes articulantur.
Fam. 2. Testacea quorum partes per cartilaginem connectuntur.

In the same year that Italy had he honour of publishing the work of Gualteri, France presented to the world the voluminous Treatise of D'Argenville. In this work, the ordinary division of shells into univalves, bivalves and multivalves, is employed; but the primary divisions depend on the animal being an inhabitant of the land, the fresh water, or the sea. The character of many of his genera correspond very nearly with those employed afterwards by Linnæus. The plates which accompany this work greatly surpass any thing of the kind which the public had seen before, being not only finely but accurately executed. D'Argenville, 1742.

In the year 1757, Adanson, in his *Histoire Naturelle du Senegal,* published a new system of conchology. His arrangement rests principally on circumstances connected with the structure and habits of the animals, to which he appears to have paid particular attention. His divisions are the following: Adanson, 1757.

History.

CLASSE I. LIMAÇONS.

SECT. I. *Limaçons Univalves.*

Adanson's arrangement.

Fam. 1. Les limaçons univalves qui n'ont ni yeux ni cornes.

Fam. 2. Les limaçons univalve qui ont deux cornes, et les yeux placés à leur racine et sur leur côte interne.

Fam. 3. Les limaçons univalves qui ont quatres cornes, dont les deux exterieurs portent les yeux sur le sommet.

Fam. 4. Les limaçons univalves qui ont deux cornes, et les yeux placés à leurs racines, et sur le côte externe, ou par derrière.

Fam. 5. Les limaçons univalves qui ont deux cornes et les yeux posés un peu au-dessus de leur racine, et sur leur côte externe.

SECT. II. *Limaçons Operculés.*

Fam. 1. Limaçons operculés qui ont deux cornes, avec un renflement, et qui portent les yeux ordinairment au-dessus de leur racine, et à leur côte externe.

Fam. 2. Limaçons opercules qui ont deux cornes sans renflement, et les yeux places à leur racine, et sur leur côte externe.

Fam. 3. Limaçons opercules, qui ont quatres cornes, dont les deux exterieures portent les yeux sur leur sommet.

CLASSE II. LES CONQUES BIVALVES.

Fam. 1. Les conques bivalve, qui ont les deux lobes du manteau separés, dans tout leur contour.

Fam. 2. Les conques bivalves dont les deux lobes du manteau forment trois ouvertures sans aucun tuyau.

Fam. 3. Les conques bivalves dont les deux lobes du manteau forment trois ouvertures dont deux prennent la figure d'un tuyau assez long.

CLASSE III. LES CONQUES MULTIVALVES.

Fam. 1. Les conques multivalves, dont aucune des pieces de la coquille ne prend la forme d'un tuyau.

Fam. 2. Les conques multivalves, dont une des pieces de la coquille prend la forme d'un tuyau qui enveloppe entierement toutes les autres.

Linnæus, 1766.

We come now to take a short view of the conchological labours of Linnæus. Considering his comprehensive genius, and the accurate views which he had with respect to arrangement, the world might have expected from his pen, a system freed from the imperfections which might have been observed in the productions of his predecessors, and at once obvious, simple, and convenient. That Linnæus fell far short of this, every one knows, who has paid any attention to the subject. Before the days of Linnæus, the secondary divisions of testaceous bodies were by far too numerous, and the characters of the genera and species vague and inaccurate. In attempting to avoid the former error, Linnæus greatly reduced all the ancient subdivisions, and even genera, and over-reached that useful simplicity which he had in view. But the greatest praise is due to this illustrious naturalist, for having employed, in the construction of his generic and specific characters, terms which were precise and applicable; and hence, his genera and species have acquired a stability which conchologists knew not before.

The primary divisions of Linnæus were such as had been in common use. He employed the divisions, univalves, and bivalves of Aristotle, and the plurivalves of Major, under the title of multivalves. And, in conformity with the general distribution of animals in his system, he placed the most complex shells, or the multivalves, at the beginning, and the univalves at the end. In the first arrangement of testaceous bodies, Linnæus only employed eight genera, *Cochlea, Nautilus, Cypræa, Haliotis, Patella, Dentalium, Concha*, and *Lepas*. In the twelfth edition, shells are distributed as follows:

History.

Linnæan arrangement.

I. MULTIVALVIA.

Gen. Chiton.	Gen. Pholas.
Lepas.	

II. BIVALVIA CONCHÆ.

Gen. Mya.	Gen. Spondylus.
Solen.	Chama.
Tellina.	Arca.
Cardium.	Ostrea.
Mactra.	Anomia.
Donax.	Mytilus.
Venus.	Pinna.

III. UNIVALVIA.

* *Spira regulari Cochlea.*

Gen. Argonauta.	Gen. Strombus.
Nautilus.	Murex.
Conus.	Trochus.
Cyprea.	Turbo.
Bulla.	Helix.
Voluta.	Nerita.
Buccinum.	Haliotis.

** *Absque spira regulari.*

Gen. Patella.	Gen. Teredo.
Dentalium.	Sabella.
Serpula.	

Remarks on the Linnæan arrangement.

This system, so much admired by the disciples of Linnæus, labours under several imperfections. Attending principally to the shells themselves, he, in a great measure, overlooked the contained inhabitant. Great pains are taken to give a description of a regularly shaped piece of carbonate of lime, while the animal in the description of the species is totally overlooked. We are aware, that, in the definition of the genera, the animals inhabiting each genus are referred to one or other of the molluscous genera. But these references are as absurd as they are useless. In vain will the student of nature look for the two tentacula and the fine fringed anus of the Dorris, in the species of the genus Chiton, which have no tentacula, and whose anus is placed at the posterior extremity; or for the four tentacula of the Limax, in the aquatic species of the Linnæan genera of Turbo and Helix. Linnæus states, as part of the character of his genus Limax: "*Foramen laterale dextrum. tentacula quatuor.*" Now, in all the aquatic species of Helices, only two tentacula can be observed; and in the reversed Turbines, the lateral pore is situated on the left side. Yet, the animals of those shells are referred to the genus Limax, by Linnæus himself! Innumerable instances of the same kind could be produced, to shew that the Linnæan arrange-

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ment nearly overlooks the contained animal, and is wholly occupied with the shell or covering, Linnæus never having paid attention to the animal. These remarks would not have been so applicable, had the peculiarities of the various species of animals, inhabiting shells, been noticed under the different molluscous genera, to which they are referred.

Many of the Linnæan genera contain species dissimilar in habit and economy to those with which they are joined. Thus, in the genera, Ostrea, Anomia, Nautilus, Turbo, Helix, and Serpula, shells very different in configuration are grouped together. This arose from his zeal to simplify, even when the subject did not admit of it.

We are at a loss to account for the licentiousness of the language employed by Linnæus, when treating of shells—language at which decency must revolt, and delicacy be offended; nor are we less astonished at succeeding authors, who have servilely copied his gross and impure allusions.

We would not wish, in this place, to be understood as condemning the Linnæan arrangement, because it is founded on the character of the shell. We only blame it for overlooking the contained animal. For no system of conchology, we believe, has ever been invented, which can lay claim to facility of practical application, where the characters are taken exclusively from the animal. If, in a correct arrangement of animals, the characters of the genera and species should be taken from obvious appearances, from parts which operate on the economy, and influence the habits of the animals, then must the shell be attended to, as affording the safest mark for a scientific distribution. The shell serves the animal as a support to its muscles and intestines, as a defence from its foes, and a protection against the vicissitudes of the element in which it resides. From the characters of the shell, therefore, all arrangement of testaceous bodies should be formed, and not from the contained animal, which, in many cases, presents itself to our notice in too imperfect a state, to admit of its being examined with a view to its classification.

O. F. Muller, 1776.

The zoological labours of O. F. Muller, have procured for him the reputation of one of the first naturalists of his age. In his distribution of shells, the characters of his genera are taken from the number and position of the tentacula of the animals in the univalves, and from the structure of the syphon in bivalves. In his Zoology of Denmark, we are presented with his latest views on the subject. He seems to have borrowed several of his characters from the works of Adanson, which we have already noticed. We will here give a short view of his system.

FAMILIA I. TESTACEA UNIVALVIA.

SECT. I. *Testacea univalvia, testa pervia.*

Muller's arrangement.

Gen. 1. *Echinus.* Testa crustacea, ano verticali, tentaculis simplicibus.
Gen. 2. *Spatagus.* Testa crustacca, ano infero, tentaculis penicillatis.
Gen. 3. *Dentalium.* Testa calcarea, testa rude, tentaculis nullis.

SECT. II. *Testacea univalvia, testa patula.*

Gen. 4. *Akera.* Apertura effusa, tentaculis nullis.
Gen. 5. *Argonauta.* Apertura profunda, tentaculis binis.
Gen. 6. *Bulla.* Apertura repanda, tentaculis binis setaceis, colliculo extrinsecus oculatis.
Gen. 7. *Buccinum.* Apertura ovata, tentaculis binis triangularibus, angulo intrinseco oculatis.
Gen. 8. *Carychium.* Apertura ovata, tentaculis binis truncatis conspicuis, angulo intrinseco oculatis.
Gen. 9. *Vertigo.* Apertura subquadrata, tentaculis binis sublinearibus, apice oculatis.
Gen. 10. *Turbo.* Apertura orbiculari, tentaculis binis setaceis, conspicuis, angulo extrinseco oculatis.
Gen. 11. *Helix.* Apertura lunari, tentaculis quatuor linearibus, apice oculatis.
Gen. 12. *Planorbis.* Apertura similunari, tentaculis binis setaceis, angulo intrinseco oculatis.
Gen. 13. *Ancylus.* Apertura totali, tentaculis binis truncatis, occultis, angulo extrinseco oculatis.
Gen. 14. *Patella.* Apertura totali, tentaculis binis setaceis, occulto angulo, extrinseco oculatis.
Gen. 15. *Haliotis.* Apertura repanda, poris pertusa.

SECT. III. *Testacea univalvia, testa operculata.*

Gen. 16. *Tritonium.* Libera, apertura canaliculata, tentaculis duobus linearibus, angulo extrinseco oculatis.
Gen. 17. *Trochus.* Libera, apertura sub-tetragona, tentaculis duobus setaceis, colliculo extrinseco oculatis.
Gen. 18. *Nerita.* Libera, apertura lunari, tentaculis duobus setaceis, angulo extrinseco oculatis.
Gen. 19. *Valvata.* Libera, apertura circinnata, tentaculis duobus setaceis, angulo postico oculatis.
Gen. 20. *Serpula.* Adnata, apertura orbiculari, tentaculis pinnatis.

FAMILIA II. TESTACEA BIVALVIA.

SECT. I. *Testacea bivalvia cardine dentata.*

Gen. 1. *Mya.* Testa altera extremitate hiante; cardine dente crasso solitario.
Gen. 2. *Solen.* Testa utraque extremitate hiante; cardine dente reflexo, sæpe gemino.
Gen. 3. *Tellina.* Siphone duplici murico; cardine dentibus utrinque tribus alternus.
Gen. 4. *Cardium.* Siphone duplici, cirrato, pedeque falciformi; cardine dentibus mediis alternis, remotis penetrantibus.
Gen. 5. *Venus.* Siphone duplici, cirrata, pedeque laminæformi, cardine dentibus tribus approximatis, lateralibus divergentibus.
Gen. 6. *Mactra.* Cardine dente medio complicato, adjacente foveola.
Gen. 7. *Donax.* Cardine dentibus duobus lateralique solitario.
Gen. 8. *Arca.* Cardine dentibus numerosis, alternis, penetrantibus.
Gen. 9. *Terebratula.* Branchiis circinnatis; cardine dentibus alterius uncinatis, valvula superiore deorsum perforata.

SECT. II. *Testacea bivalvia, cardine edentulo.*

Gen. 10. *Anomia.* Branchiis simplicibus; valvula inferiore perforata.
Gen. 11. *Ostrea.* Branchiis simplicibus, pede nullo; cardines fossula cava.
Gen. 12. *Pecten.* Branchiis cirratis, pede juxta auriculum cardine fossula ovata byssum emittens.
Gen. 13. *Mytilus.* Siphone duplici brevi; fossula lineare, byssum emittens.

FAMILIA III. TESTACEA MULTIVALVIA.

Gen. 1. *Chiton.* Valvulæ dorsales, tentacula nulla.
Gen. 2. *Lepas.* Valvulæ erectæ, tentacula bipartita.

History.

Gen. 3. *Pholas.* Valvulæ ad cardinem minores.

We are under the greatest obligations to this author, for the extension of our knowledge of the inhabitants of the testacea, and for the excellent figures of those which he has given.

Da Costa, 1776.

Da Costa, whose elements of conchology appeared in 1776, attempted a new arrangement of shells. Labouring to steer clear of the system of the Swedish naturalist, against whom he throws out several abusive strictures, he invented so many new terms, that his system never gained him much reputation. He was, however, well versed in the science of conchology.

To the modern naturalists of France, the science of conchology is under great obligations. They have studied the structure of the animals which inhabit shells with care, and have struck out several new views, to aid us in the formation of a natural system.

Bosc.

The work of L. A. Bosc, entitled *Histoire Naturelle des Coquilles, des Vers et des Crustacés*, contains a new arrangement of shells, differing somewhat from the Linnæan, and, in our opinion, preferable to that system. The following is a tabular view of his system.

Bosc's arrangement.

I. Coquilles. Multivalves.

1. *Les unes n'ont point de charnière.*

Genre Oscabrion. Genre Balanite.
Anatif.

2. *Les autres en ont une.*

Genre Pholade. Genre Anomie.
Taret. Calceole.
Fistulane.

II. Coquilles Bivalves.

1. *Elles sont on Inéquivalves.*

Genre Térébratule. Genre Avicule.
Cranie. Marteau.
Lingule. Vulselle.
Hyale. Huitre.
Orbicule. Gryptee.
Corbule. Plicatule
Pandore. Spondyle.
Houlette. Came.
Lime. Acarde.
Peigne. Radiolite.
Placune. Erodone.
Perne.

2. *Ou Equivalves.*

Genre Mye. Genre Mactre.
Glycemère. Crassatelle.
Solen. Trigonie.
Telline. Hiatelle.
Cyclade. Cucullée.
Venus. Arche.
Onguline. Nucule.
Donace. Mulette.
Carditte. Anodonte.
Hippope. Moule.
Tridacne. Pinne.
Bucarde.

III. Coquilles Univalves.

1. *Elles sont ou Uniloculairc.*

A. Celles qui sont en spirale.

History.

Bosc's arrangement.

* Sont ou en calotte.
Genre Patelle.
Oscane.
** Ou en tube.
Genre Vermiculaire.
Silicaire.
Arrosoir.

B. Celles qui sont sans spirale.
* Sont ou l'ouverture entière et sans canal a sa base.

Genre Carinaire. Genre Helice.
Haliotoide. Volvaire.
Sigaret. Bulle.
Stomate. Jacinthe.
Argonaute. Turritelle.
Concholepas. Cyclostome.
Nérite. Bulime.
Natice. Sabot.
Helicine. Toupie.

** Ou l'ouverture echancrée et canaliculée a sa base.

Genre Cerite. Genre Vis.
Pyrule. Pourpre.
Rocher. Volute.
Rostelaire. Ovule.
Strombe. Tarriere.
Buccin. Porcelaine.
Casque. Cone.

2. *Ou Multiloculaires.*

Genre Nautile. Genre Turrilite.
Orbulite. Baculite.
Ammonite. Spirule.
Planulite. Orthocèe.
Camerine. Hippurite.
Rotulite. Belemnite.

Bruguière.

The name of Bruguière will long be remembered. He had undertaken the helminthological department of the *Encyclopédie Methodique*, but a premature death deprived the world of his labours. He had finished the first volume of the article *Vers*, which does not go beyond the letter C. The figures which he subjoined are faithful representations. To Lamarck, we are indebted for several judicious observations on the system of Bruguière. Afterwards he published his *Systême des Animaux sans Vertebres*, in which a new arrangement of testaceous bodies is attempted. This system of Lamarck's was afterwards more fully illustrated by Latreille, in his *Tableau Methodique des Mollusques*, inserted in the 24th vol. of the *Nouveau Dictionnaire d'Histoire Naturelle*. The following short view of his system, will serve to illustrate the principles upon which it is formed. The animals which inhabit shells are described, along with the Linnæan mollusca, in his fifth class *Mollusques*, and in his sixth class, to which he has given the name of *Annelides*. This last class includes the annular mollusca of Linnæus, and a few of the inhabitants of testaceous bodies.

Lamarck.

Latreille, 1804.

Latreille's arrangement.

ORDRE PREMIER. CÉPHALÉS CEPHALA.

Une tete distincte et mobile; souvent des yeux.

Sect. I. *Cors nu.*

Genre Sigaret, *Sigaretus.*
Oscabrion, *Chiton.*

History. Latreille's arrangement.

SECT. II. *Cors Renfermé dans une Coquille.*

DIVISION 1. Coquille univalve, non spirale, recouvrant simplement l'animal.

Genre Patelle, *Patella.*
Fissurelle, *Fissurella.*
Emarginule, *Emarginula.*
Concholepas, *Concholepas.*
Crépidule, *Crepidula.*
Calyptrée, *Calyptræa.*

DIVISION 2. Coquille univalve, uniloculaire, spirivalve, engaînant ou contenant l'animal.

A. Ouverture échancrée ou canaliculée a sa base.

Genre Cône, *Conus.*
Porcelaine, *Cypræa.*
Ovule, *Ovula.*
Tarière, *Terebellum.*
Olive, *Oliva.*
Ancille, *Ancilla.*
Volute, *Voluta.*
Mitre, *Mitra.*
Colombelle, *Columbella.*
Marginelle, *Marginella.*
Cancellaire, *Cancellaria.*
Nasse, *Nassa.*
Pourpre, *Purpura.*
Buccin, *Buccinum.*
Eburne, *Eburna.*
Vis, *Terebra.*
Tonne, *Dolium.*
Harpe, *Harpa.*
Casque, *Cassis.*
Strombe, *Strombus.*
Ptérocère, *Pterocera.*
Rostellaire, *Rostellaria.*
Rocher, *Murex.*
Fuseau, *Fusus.*
Pyrule, *Pyrula.*
Fasciolaire, *Fasciolaria.*
Turbinelle, *Turbinellus.*
Pleurotome, *Pleurotoma.*
Clavatule, *Clavatula.*
Cérite, *Cerithium.*

B. Ouverture entière et sans canal a sa base.

Genre Toupie, *Trochus.*
Cadran, *Solarium.*
Sabot, *Turbo.*
Monodonte, *Monodonta.*
Cyclostome, *Cyclostoma.*
Scalaire, *Scalaria.*
Maillot, *Puppa.*
Turritelle, *Turritella.*
Janthine, *Janthina.*
Bulle, *Bulla.*
Bulime, *Bulimus.*
Agathine, *Achathina.*
Lymnée, *Lymnæa.*
Mélanie, *Melania.*
Pyramidelle, *Pyramidella.*
Auricule, *Auricula.*
Volvaire, *Volvaria.*
Ampullaire, *Ampullaria.*
Planorbe, *Planorbis.*
Hélice, *Helix.*

Genre Helicine, *Helicina.*
Nérite, *Nerita.*
Natice, *Natica.*
Testacelle, *Testacella.*
Stomate, *Stomatia.*
Haliotide, *Haliotis.*
Vermiculaire, *Vermicularia.*
Siliquaire, *Siliquaria.*
Arrosoir, *Penicellus.*
Carinaire, *Carinaria.*
Argonaute, *Argonauta.*

DIVISION 3. Coquille univalve, multiloculaire, engaînant ou renfermant l'animal.

Genre Nautile, *Nautilus.*
Orbulite, *Orbulites.*
Ammonite, *Ammonites.*
Planulite, *Planulites.*
Nummulite, *Nummulites.*
Spirule, *Spirula.*
Turrilite, *Turrilites.*
Baculite, *Baculites.*
Orthocère, *Orthocera.*
Hippurite, *Hippurites.*
Belemnite, *Belemnites.*

Genres incomplètement connus.

1. Coquille univalve uniloculaire.

Genre Planospirite, *Planospirites.*
Oscane, *Oscana.*

2. Coquille univalve sub-multiloculaire.

Genre Rotalite, *Rotalites.*

3. Coquille univalve sub-uniloculaire.

Genre Gyrogonite, *Gyrogonites.*

ORDRE SECOND. ACÉPHALÉS ACEPHALA.

Point de tête distincte; jamais d'yeux.

SECT. I. *Corps nu.*

SECT. II. *Cors renfermé dans une coquille.*

DIVISION 1. Coquille Equivalve.

Genre Pinne, *Pinna.*
Moule, *Mytilus.*
Modiole, *Modiola.*
Anodonte, *Anodonta.*
Mulette, *Unio.*
Nucule, *Nucula.*
Petoncle, *Pectonculus.*
Arche, *Arca.*
Cucullée, *Cucullæa.*
Trigonie, *Trigonia.*
Tridacne, *Tridacna.*
Hippope, *Hippopus.*
Cardite, *Cardita.*
Isocarde, *Isocardia.*
Bucarde, *Cardium.*
Onguline, *Ungulina.*
Crassatelle, *Crassatella.*
Paphie, *Paphia.*
Lutraire, *Lutraria.*
Mactre, *Mactra.*

History.

Latreille's arrangement.

Genre Erodone, *Erodona.*
Petricole, *Petricola.*
Donace, *Donax.*
Meretrice, *Meretrix.*
Venus, *Venus.*
Venericarde, *Venericardia.*
Cyclade, *Cyclas.*
Lucine, *Lucina.*
Telline, *Tellina.*
Capse, *Caspa.*
Sanguinolaire, *Sanguinolaria.*
Solen, *Solen.*
Glycemère, *Glycemeris.*
Mye, *Mya.*
Pholade, *Pholas.*

Division 2. Coquille Inéquivalve.

A. Valve principale tubuleuse.

Genre Taret, *Teredo.*
Fistulane, *Fistulana.*

B. Deux valves ou simplement oppose, ou articulées ou charniere.

Genre Acarde, *Acardo.*
Radiolite, *Radiolites.*
Chame, *Chama.*
Spondyle, *Spondylus.*
Plicatule, *Plicatula.*
Gryphée, *Gryphæa.*
Huitre, *Ostrea.*
Vulselle, *Vulsella.*
Marteau, *Malleus.*
Avicule, *Avicula.*
Perne, *Perna.*
Crénatule, *Crenatula.*
Placune, *Placuna.*
Peigne, *Pecten.*
Lime, *Lima.*
Houlette, *Pedum.*
Corbule, *Corbula.*
Anomie, *Anomia.*
Cranie, *Crania.*
Terebratule, *Terebratula.*
Calceole, *Calceola.*
Hyale, *Hyalæa.*
Orbicule, *Orbicula.*
Lingule, *Lingula.*

In the sixth class of animals, according to Latreille, the Annelides, the remaining testaceous animals, are placed.

Division 2. Point Organes extérieurs.

Sect. II. *Animal se logeant dans un fourreau.*

Genre Dentale, *Dentalium.*
Spirorbe, *Spirorbis.*
Serpule, *Serpula.*
Vaginelle, *Vaginella.*
Speroglyphe, *Speroglyphus.*
Anatife, *Anatifa.*
Balane, *Balanus.*

Account of British Conchologists.

We have thus, in succession, given an abridged view of the most remarkable testaceological systems which have made their appearance; and we propose now to conclude the historical part of our observations, with a short sketch of the principal British naturalists who have elucidated the history of the shells which occur on our shores.

History.

Authors who have treated of British testaceology.

Merret, 1667.

In the year 1667, Merret published his *Pinax rerum Naturalium Britannicarum.* This work contains the first attempt to enumerate the productions of Britain. The *testacei,* as he terms shells, occupy little more than a page. The references are chiefly to Jonstone, Aldrovandus, and Gesner. His account of shells is destitute of system, and does not contain any description of species.

Lister, 1678.

Lister, in 1678, published his *Historia Animalium Angliæ,* and in the year 1681 an Appendix. This work contains a full account of the English shells known to that author. His descriptions in general are good, and the delineations of the shells correct.

Sibbald, 1684.

Sir Robert Sibbald, by whom the natural history of Scotland was very ably elucidated, published, in 1684, his *Scotia Illustrata.* In 1697, he published his *Auctarium Musæi Balfouriani,* and some other papers relative to conchology, in the *Philosophical Transactions.* His description of the shells of Scotland appears to us destitute of correct arrangement, generic characters, or specific distinctions.

Wallace, 1700.

Dr Wallace, in the year 1700, published an *Account of the Islands of Orkney.* In this work, he enumerates all the species which had come under his observation, amounting to nearly fifty, and has added a very good figure of the *Pecten distortus.*

We ought in this place, did our limits allow us, to notice the topographical labours of Leigh, in his *Natural History of Lancashire*—of Plot, in his *Natural History of Staffordshire and Oxfordshire*—of Morton, in his *Natural History of Northamptonshire.* In these works, the testacea are treated of in a very superficial manner. Nor can we say much more of the Hibernian historian, Dr Charles Smith, who, in his account of the counties of Waterford, Cork, and Kerry, has noticed a few of the more common species.

Pennant, 1777.

In 1777, Pennant completed his *British Zoology.* In this work, for the first time, were the animals of Britain classified according to the Linnean method of arrangement; and we believe, few works ever contributed so much to the extension and cultivation of British natural history. In the fourth volume of the above work, he enumerates 163 species of testacea, with concise descriptions, and many excellent figures. A new edition of this work has lately appeared under the inspection of his son, in which the recently discovered species have been added to those described in the former edition.

Da Costa, 1778.

In 1778, Da Costa published his *British Conchology.* His descriptions of the species are copious, and the work is embellished with 123 figures of rare shells. The arrangement of the shells in this work is according to the system which he had previously formed.

Microscopic shells.

In the year 1739, Plancus gave an account of the minute and rare shells discovered at Rimino, on the coast of the Adriatic sea. The shells which Plancus described were minute, and required the aid of the microscope for their examination. In this country, Mr Boys and Mr Walker turned their attention to these minute testacea, and discovered many new and curious species on the British shores. The labours of these inquirers were made known to the world in the year 1784, in a small quarto volume, entitled, *Testacea Minuta rariora nuperrime detecta in Arena Littoris Sandvicensis.* Many of these microscopic species are exceedingly beautiful, and appear to be widely distribu-

Boys and Walker, 1784.

History.

ted. We know, that many of the species are common to the south coast of England and the shores of the Zetland Islands. The microscopic species of shells have, since the labours of Boys and Walker, been very successfully examined by Mr Adams, in the third and fifth volumes of the *Transactions of the Linnean Society.*

Gordiner, 1788.

In the year 1788, Cordiner's *Remarkable Ruins and Romantic Prospects of North Britain,* appeared in numbers. Several plates of marine vermes are added, with descriptions. But these are too loose and inaccurate to be of any practical utility. Among the plates is a very good figure of Solen Minutus, and several Serpulæ.

Berkenhout, 1795.

Berkenhout published his *Synopsis of the Natural History of Great Britain and Ireland,* in the year 1795. This work contains a very correct list of the British testacea then discovered.

Pulteney, 1799.

In the year 1799, Dr Pulteney's catalogue of the shells of Dorsetshire appeared in Hutchinson's new and enlarged edition of the history of that country. This catalogue is very valuable, on account of the clear and concise specific characters attached to many of the species. The figures which he has given of many of the species described by him, are accurate and faithful representations of nature.

Donovan, 1799.

Mr Donovan, whose works on natural history have gained him so much reputation, commenced, in the year 1799, his work on *British Shells,* and in the year 1804, five volumes completed the plan. The work contains short descriptions of the different species, with well executed figures. The greater number of microscopic shells are excluded; and what seems a little surprising, no notice is taken of any of the species of the genus Chiton.

Montagu.

The conchological labours of Mr Montagu are entitled to the highest praise. His *Testacea Britannica* exhibits innumerable traces of perseverance, observation, and accuracy. In consequence of his situation on the sea-coast, he has had excellent opportunities of examining the animals of shells, which he has embraced. Two parts of his work appeared in 1803, and a supplement was published in 1808. The system which Mr Montagu follows is decidedly the Linnæan, on which he has endeavoured to make some improvements. He is the first British conchologist who has devoted much attention to the contained animals. The species described are upwards of 470 in number. The figures of the shells contained in thirty plates, are very just representations of nature, and do great credit to the female hand which executed them.

Maton and Rackett.

The descriptive catalogue of British Testacea, inserted in the 8th volume of the Linnæan Transactions, is a valuable addition to the British conchologist. It is the joint production of Dr Maton and the Rev. Thomas Rackett. The Linnæan arrangement and terminology are employed throughout. Many obscure species are here admirably elucidated, and the errors of preceding conchologists rectified.

Laskey.

1811

In the first volume of the Memoirs of the Wernerian Natural History Society, we are presented by Captain Laskey with a list of North British testacea, amounting to 271 species. Some of these are new. To the list is added a plate of well-executed figures.

TERMS USED IN CONCHOLOGY.

Terms used in conchology.

Explanation of Terms used in the Description of Univalves.

Cavity.

The *cavity* of univalves, or the space which the shell incloses, is, in a few species, divided into *chambers,* which have a pipe of communication, termed a *syphon.*

Terminology.

Base.

The *base* is considered as situated in the external orifice of the shell or *mouth,* and the opposite extremity of the shell is termed the *apex,* or *summit.* In the genus Spirorbis, the base is considered as that portion of the shell which adheres to rocks and sea-weeds. The mouth, in some species, possesses a testaceous *lid,* or *operculum.* This lid is generally attached to the organ of motion, and appears to be an instrument of defence. When the animal withdraws itself into the shell, the lid closes the orifice, and secures it from an attack. The edge of the mouth is termed its *margin.*

Whorls.

Some shells are simply tubular or conical; but the greater part are variously convoluted, the volutions being termed *whorls,* or spires. These whorls are in general visible and distinct, the boundary between each being termed the *line of separation.* The whorls in some species are simply placed in a lateral position, while in others the whorls are formed upon a *pillar,* or columella, which runs in the direction of the axis of the shell, the inferior whorl in this case embracing the superior one. The pillar is in some cases nearly solid, in other instances tubular, with its base either open or covered. When the base of the tube of the columella is uncovered, the opening is termed the *pillar cavity,* or umbilicus.

Dextral shells.

In general, when a spiral shell is placed upon its base or mouth, with the apex towards the observer, the mouth will be found situated on the right side, and the whorls will be observed revolving in a direction from right to left, or corresponding with the motion of the sun. These shells are termed *dextral.* A few species have this order reversed, as the observer will readily perceive. For upon placing the shell in the above-mentioned position, the mouth will be found situated on the left side, and the whorls will revolve from left to right. These shells are termed *sinistral,* heterostrophe, or heteroclite.

Sinistral shells.

Epidermis.

Several shells are furnished externally with a thin skin, or *epidermis.* The use of this covering, we have not been able to ascertain. It is common to the other classes of shells also. Some authors have supposed that it secured the shell from being covered with vermes. If this supposition were true, we would not see the Mussles, even when very young, overrun with Zoophytes and Balani.

Explanation of Terms used in the Description of Bivalves.

Hinge.

The two sides of bivalves move upon a certain point, as a fulcrum, which is termed the *hinge.* This part in some shells is smooth, in others it is furnished with *teeth,* or small eminences, with which the inner surface of the hinge is set. On each side of the hinge there are usually small projections of the shell, which are denominated *beaks,* or umbones. These are either reflex, divaricate, or spiral. Near the hinge there is a strong cartilaginous membrane, which connects the valves, and which is termed the *ligament,* under which, and towards the beak, there is usually a groove, called a *chink.*

Base.

The *base* of bivalves is considered as situated in the beak. This has been objected to by some conchologists, and the opening or mouth, as in univalves, proposed as the proper base. But when we consider the beak as the centre of motion, containing the hinge upon which the valves turn, we feel ourselves justified in retaining the Linnæan definition, or the one already mentioned. The *margin* of the shell occupies the circumference of the valves and is divided into four parts. The *inferior margin,* or the margin of the hinge; the *anterior margin,* or the margin next to the ligament; the *posterior*

Terminology.

margin, or the margin on the side of the beaks opposite to the ligament. In this margin there is usually a small depression, or lunule. The *superior margin* occupies that portion of the shell which is situated between the ligament and posterior margin, and is opposite to the hinge. In some species, the valves are unconnected in part; these shells are said to have the *margin gaping*.

Valves. The valves of shells are divided into *right* and *left*, *equal* and *unequal*, *equilateral* and *inequilateral*. If the shell is placed upon its base or hinge, with the ligament behind, then the right and left sides of the shell will correspond with those of the observer. When both valves agree in size and form, then they are said to be equal. The *length* of a shell is in the direction of a line drawn from the beaks to the superior margin; the *breadth* is in the direction of a line drawn at right angles to the former. When the longitudinal line divides the valves into two equal parts, then the shell is said to be *equilateral*; if into unequal parts, it is termed *inequilateral*.

Cicatrix. The *cicatrix* is a mark left on the inside of the valves, at the point where the muscles adhered.

Beard. The *beard*, or byssus, is a thread-like substance by which certain species adhere to stones and rocks.

Explanation of Terms used in the Description of Multivalves.

Valves. In some of the genera, the valves are so strongly united, that they seem to form one shell; these are said to be *articulated*. In others, a membranaceous substance, termed the *ligament*, connects the valves together, and sometimes lines the cavity of the shell.

Base. The *base* is sometimes affixed to other bodies directly, or possesses an intervening tubular fleshy *peduncle*. The *accessory valves*, or operculum, in some close, the principal entrance like a lid; in others, they are united to the primary valves.

Having thus noticed, in succession, the principal conchological systems which have made their appearance; and having explained a few of the terms generally used in the science, we now proceed to lay before our readers a system of British conchology. Had we attempted to give a description of all the known species and genera which have been ascertained, we would have increased the article to an unwarrantable length; and to have confined ourselves to the description of the genera merely, would have rendered the present remarks of less general utility. We propose to give at present a description of all the British species, with a few remarks illustrative of their history; and under the article TESTACEOLOGY, to give an account of all the known genera, with an enumeration of all the species which have been referred to each genus.

Instead of adopting the Linnæan arrangement, which in many respects we view as defective and unnatural, we have only conformed to his general divisions, placing the univalves, however, in the first, and the multivalves in the last division. This was the ancient method of distributing shells, and certainly the most obvious. The student of nature is, by such a method, led from the examination of the more simple shells, to those which are more complicated in their structure, and thus pursues the plan so successfully followed in the other sciences. We have judged it expedient to make a few alterations in the distribution of the univalves, for the purpose of bringing more closely together shells naturally allied. Thus we have placed those univalves whose cavity is entire, or *unilocular*, in a separate division from those shells which are furnished with a many-celled cavity, or which may be termed *multilocular*.

The unilocular shells admit of a twofold division. Those destitute of a columella, or pillar round which the shell revolves; and those which are furnished with a columella, or pillar. This proposed arrangement, requires the formation of a few new genera. From this little confusion can arise, as we have invariably retained the *specific* appellations by which the shells are at present known, and have mentioned the genera to which they formerly belonged. We have ventured to add a few new species to the testacea of Britain, which have come under our own inspection. Of these, drawings will be given.

When describing the several species of British shells, we shall sometimes give a description of the contained animal when necessary, for the purpose of specific distinction. Under the article MOLLUSCA, we propose to lay before our readers a description of the different inhabitants of shells, with remarks illustrating their physiology.

ORDER I. UNIVALVES.

Univalves. THIS division of testaceous bodies was first proposed by Aristotle, and has been more or less employed by every succeeding conchologist. All those species are included in this division whose shell is composed of one piece, destitute of a hinge, and not furnished with any accessory valves.

The order admits of a twofold division, for the purpose of separating the unilocular shells from those which are multilocular.

DIVISION I. UNILOCULAR.

Unilocular shells. THE unilocular shells were first separated from the multilocular species by Breynius, as appears from the use which he made of the terms Monothalamia and Polythalamia. Bose has employed, for the same purpose, the terms Unilocular and Multilocular in his system. Although less expressive than the terms of Breynius, they are more generally understood. The shells of this division have a one-celled cavity, and are more simple in their formation than the multilocular testacea. They admit of a division into two sections; those which are destitute of a pillar may be termed Astulidia, and those which are furnished with a pillar Stulidia.

SECT. I. ASTULIDIA.

Astulida. The shells which we include in this section, are such as are destitute of a pillar or columella upon which they are formed. Those species which are spiral, have the whorls placed laterally, and do not revolve round the pillar. This section we propose to divide into four families, characterised by a difference in the shape of the shell. These families may be denominated expanded, tubular, flask-shaped, or spiral.

FAMILY I. EXPANDED.

In this family the cavity of the shell is open and conspicuous, and the mouth is large and spreading. It was first formed by Breynius, and named Lepas, as it included the Patellæ, which were known to Aristotle by the name of Lepas. The family contains three genera, Patella, Haliotis, and Sigaretus.

Univalves.

Genus I. Patella. *Limpet.*

I. Patella. *Shell subconical, mouth large basin-shaped.*

Obs. The inhabitants of this genus resemble the Limaces of the mollusca order of Linnæus. The species admit of distribution into six subdivisions, which Latreille has constituted into as many genera.

A. Suborbicular, simple beneath, vertex entire, margin destitute of fissures. *Patella.*

Vulgata, 1. *Vulgata.* Common Limpet. Shell subconical, with about fourteen obsolete angles, vertex nearly central, mouth subovate, margin indented; diameter about two inches.

Brit. Zool. tab. 89. fig. 145, 146.

This species is subject to numerous variations in colour and shape. The young shells are flat, with deeply indented margins and a lateral vertex. The old shells are usually smoother, more conical, and have the vertex nearly central. This is a very common shell, adhering to rocks and stones.

Cœrulea, 2. *Cœrulea.* Shell translucent, subovate, slightly wrinkled concentrically, and rayed with bluish lines from the vertex to the margin; vertex nearly central, protuberant, worn, margin waved; inside glossy, pavonine; length an inch, breadth eight-tenths, height five-tenths.

Brit. Zool. tab. 90. fig. 151.
Test. Brit. Sup. page 132.

In the young state this shell is depressed, the vertex is protuberant and lateral. In the vertex two small spots of a black colour may sometimes be observed; such shells have been hastily constituted into a distinct species under the title *P. bimaculata.* This species is common in England and Scotland. It feeds on the stalks of *Fucus digitatus,* in which it forms a circular cavity.

Pellucida, 3. *Pellucida.* Shell thin, horn coloured, rayed with dotted lines of azure, most conspicuous from the vertex to the broadest end, oval, rounded at top, with an obscure vertex at the narrow end of a black colour; margin entire even; length about an inch, breadth five-eighths, height three eighths.

Brit. Zool. tab. 90. fig. 150.
Pult. *Dorset.* tab. 33. fig. 5.
British Shells, tab. 3. fig. 1. 1. 1.

This shell varies a little in its markings. Linnæus states the number of coloured rays at four. In young specimens we have observed them entirely wanting, their place being supplied by brown lines. In the older specimens they sometimes exceed thirty, and the shell is furnished with obsolete ribs. Common on the coast of England and Scotland.

Elongata, 4. *Elongata.* Shell pale brownish white, with darker coloured obsolete rays, opake, dull, somewhat pointed before, vertex rounded; length three-tenths, breadth two-tenths, height one-tenth.

A new species found at St Andrew's, Fifeshire, by Miss Lambert.

Parva, 5. *Parva.* Shell reddish white, with about sixteen pale reddish lines from the vertex to the margin, outside dull, inside glossy, subconical, oval, slightly wrinkled concentrically; vertex a little pointed, approaching the narrow end; length about four-tenths, breadth three-tenths, height one-eighth of an inch.

Brit. Shells, tab. 21. fig. 2.
Pult. *Dorset.* tab. 14. fig. 11.

Frequent on rocks and stones about low-water mark.

Elliptica, 6. *Elliptica.* Shell elliptical, margin entire, vertex a little pointed, strong, dull, opake; length four-tenths, breadth three-tenths, height scarcely two-tenths.

This shell resembles the preceding species, and may be easily mistaken for it. The dullness, opacity, and want of coloured lines, are the marks by which it may be distinguished. A new species found on stones in Zetland.

Distorta, 7. *Distorta.* Shell subquadrangular, depressed, wrinkled. colour brown, destitute of lustre, vertex nearly central, small, margin uneven, flattened; length five-tenths, breadth four-tenths, height two-tenths.

A new species found adhering to stones dredged in deep water off the coast of Zetland.

Rota, 8. *Rota.* Shell white, opake, round, with a regularly toothed margin.

Test. Min. Rar. tab. 1. fig. 16.

A minute species from Sandwich, rare.

B. Oblong, vertex pointed and leaning on the margin. *Crepidula.*

Intorta, 9. *Intorta.* Shell ovate, with upwards of twenty equidistant tuberculated ribs, and alternate, obsolete, smaller ones; vertex towards the narrow end, and turning downwards, margin slightly indented with the ribs; length three-fourths of an inch, breadth about half an inch, the height somewhat less.

Brit. Zool. tab. 90. fig. 148.
Brit. Shells, tab. 146.

First found in Anglesea by Mr Pennant, and since on the coast of Devon and in the Frith of Forth by Mr Laskey.

Lacustris, 10. *Lacustris.* Shell entire, oval, subconical, vertex near to one end, hooked, mouth oval, margin even and thin, inside glossy, outside covered with a dark green epidermis; length three eighths, breadth two eighths, height not quite so much.

Pult. *Dorset.* tab. 22. fig. 8. 8.
Brit. Shells, tab. 147.

Common in rivulets adhering to stones, seldom to the leaves and stalks of aquatic plants.

Oblonga, 11. *Oblonga.* Shell entire, membranaceous, pale horn coloured, oblong, compressed; vertex pointed, turned to one side, mouth oval, margin entire, inside smooth, glossy, outside covered with a brownish epidermis; length four eighths, breadth two eighths, and height one eighth.

Phil. Trans. vol. lxxvi. tab. 3. fig. 1, 2, 3, 5.
Pult. *Dorset.* tab. 18. fig. 20.
Brit. Shells, tab. 150.

On plants, in ditches, and ponds; not uncommon.

C. Oval, summit produced into a beak, somewhat twisted, and reclining towards the left margin. *Concholepas.*

Antiquata, 12. *Antiquata.* Shell thick, opake, white, subconical, with concentric imbricated wrinkles, vertex obliquely pointing upwards, or extending and recurved; mouth oval, about half an inch wide.

Test. Brit. tab. 13. fig. 9.
Pult. *Dorset.* tab. 22. 72.

First observed at Weymouth by Mr Bryer, and afterwards in the Frith of Forth by Mr Laskey.

Hungarica, 13. *Hungarica.* Shell conical, striated, acuminated; vertex reflected, terminating in a spiral turn underneath; mouth circular, about an inch in diameter; margin waved; epidermis of a brown colour, with a ciliated border; height five eighths of an inch.

Brit. Zool. tab. 90. fig. 147.
Brit. Shells, tab. 21. fig. 1. 1.

Not uncommon on the west coast of England, and the east coast of Scotland.

Univalves. 14. *Militaris.* Shell subconical, decussated with fine striæ; vertex recurved, and turned to one side; mouth circular, about half an inch wide, inside glossy, white.

Test. Brit. tab. 13, fig. 11.
British Shells, tab. 171.

First noticed as British by Dr Pulteney; found at Weymouth by Mr Bryer; in Cornwall by Miss Pocock; and in the Frith of Forth by Mr Laskey.

D. Oval, subconical, with a perforated summit. *Fissurella.*

Græca, 15. *Græca.* Shell oblong, oval, thick, of a brown colour, strongly reticulated; vertex truncated, with an oblong perforation, margin somewhat indented or arcuated; length about three quarters of an inch, breadth half an inch, height a quarter.

Brit. Zool. tab. 89, fig. 153.
Pult. *Dorset.* tab. 23, fig. 3.
Brit. Shells, tab. 21, fig. 33.

Not uncommon on the English coast.

Apertura, 16. *Apertura.* Shell subconical, white, marked with strong tuberculated ribs, with a few circular ridges; vertex reflected, small, turning downwards, above which is a rhomboidal perforation; mouth oval, margin crenated; length about a quarter of an inch, height one-eighth.

Test. Brit. tab. 13, fig. 10.

Found by Mr Montagu at Falmouth and in Salcomb bay. We have observed it in Zetland.

Zetlandica, 17. *Zetlandica.* Shell white, pellucid, glossy, oblong, furrowed from the vertex to the margin with tuberculated ribs; vertex obtuse, marginal, with an oval perforation; mouth ovate, margin waved; length scarcely a line.

This new species was observed among small shells from Zetland.

Marginata, 18. *Marginata.* Shell white, pellucid, glossy, smooth, oblong; margin waved; vertex pointed, marginal, with an oval perforation, surrounded with a raised border; length about half a line.

Found with the preceding species in Zetland.

E. Posterior margin furnished with a slit, summit entire. *Emarginula.*

Fissura, 19. *Fissura.* Shell oval, conical, striated, reticulated; vertex a little reflected; mouth oval, margin crenated, with a slit behind reaching about one-fourth of the length of the shell towards the vertex, inside smooth, glossy; length half an inch, height and breadth about two-eighths.

Brit. Zool. tab. 90. Fig. 152.
Brit. Shells. tab. 3. fig. 3.

In England and Scotland not frequent.

F. Conical, cavity furnished with a thin plate, or tooth-like process. *Calyptræa.*

Chinensis. 20. *Chinensis.* Shell entire, subconical, of a pale brown or whitish colour; vertex central, slightly wrinkled concentrically; mouth circular, inside glossy, smooth, furnished with a flat thin plate, standing obliquely to the side of the shell; breadth five-eighths, height two-eighths.

Brit. Shells, tab. 129.
Test. Brit. tab. 13. fig. 44.

First noticed as British, by Col. George at Penryn. It has since been found at Salcomb bay by Mr Montagu, and in the Frith of Forth by Mr Laskey.

Genus II. Haliotis.

II. Haliotis. *Shell ear-shaped, flat, spire lateral, and nearly concealed; disk pierced with holes, in a line parallel with the inner margin; mouth wide, longer than its breadth.*

1. *Tuberculata.* Lin. Shell strong, opake, oval, striated longitudinally, and wrinkled transversely; near the inner margin, a ridge beset with tubercles, increasing in size to the front, where a few of them are pervious; inside pearlacious; length 4 inches, breadth 3 inches. Tuberculata.

Brit. Zool. tab. 88, fig. 144.
Pult. *Hist. Dorset.* tab. 22. fig. 1. 1.
Don. Brit. Shells, tab. 5.

Adheres to rocks; found after storms on the western and southern coasts of England; common in Guernsey, where the animal is used for food.

Genus III. Sigaretus.

Shell ear-shaped, with an obsolete spire, aperture large, inner margin turned inwards; disk without orifices. III. Sigaretus.

1. *Haliotoidea.* Shell thin, pellucid, white, glossy, finely wrinkled across; aperture oval, nearly extended to the apex; inner margin turned inwards, outer margin thin, membranaceous; apex small, and making nearly two volutions; length three-fourths, breadth half an inch. Haliotoidea.

Lin. *Syst. Nat.* p. 1250, No. 713. Helix haliotoidea.
Mont. *Test. Brit.* tab. 7, fig. 6. Bulla haliotoidea.
Pult. *Hutch. Dor.* tab. 22, fig. 5.*

On the coast of Devon and Dorset, by Mr Montagu; at Weymouth, by Mr Bryer; at Portobello sands, Scotland, by Mr Laskey; and we have found it in Zetland.

This shell was placed by Linnæus in the genus Helix, in the family Ovatæ imperforatæ. By Montagu, and the authors of the Descriptive Catalogue, it is placed among the Bullæ. Its form points out at once its relation to the preceding genus, with which it would have been united by Linnæus, had it possessed the row of tubercles on the disk. Its shape and inflated margin forbid its insertion either in the genus Bulla or Helix. Its animal completely envelopes the shell. The present genus was formed by Lamarck, who places it among the naked mollusca, in company with the dorris and chiton.

Family II. TUBULAR.

This family of shells was first pointed out by Langius, under the title *Tubuli marini.* Their form is that of a narrow tube, usually sub-cylindrical, or tapering to a point. The family contains three genera, *Dentalium*, *Cœcum*, and *Serpula.*

Genus IV. Dentalium.

Shell tubular, nearly straight, tapering; apex pervious. IV. Dentalium.

1. *Entalis.* Shell subarcuated, tapering to a small point, often marked with circular wrinkles and bands, colour white; length half an inch, diameter at the largest end about two-tenths. Entalis.

Brit. Zool. tab. 90, fig. 154.
Don. *B. Shells*, tab. 48.

Not uncommon in England and Scotland. It appears to be an inhabitant of deep water.

2. *Dentalis*, Lin. Shell tapering, subarcuated, very small at the point; striated longitudinally; striæ about 20 in number; length half an inch. Dentalis,

Test. Brit. p. 435. D. Striatum.

Found on the shores of Cornwall and Devon by Mr Montagu.

Univalves. Striatulum. 3. *Striatulum.* Shell tapering, subarcuated, with eight ribs or angles, and intermediate striæ.

Don. *Brit. Shells*, tab. 162. D. Octangulatum.

Found on the sandy coast of Cornwall, near Lelund, by Miss Pocock.

Gadus. 4. *Gadus.* Subarcuated, tapering, smooth, white, contracting a little toward the larger end; length about three-eighths of an inch.

Test. Brit. p. 496. tab. 14. fig. 7.

First described by Montagu, who says that it is found in many parts of the British channel, and known to mariners by the name of *Hake's-tooth.*

Genus V. Cæcum.

V. Cæcum. *Shell tubular, subcylindrical, subarcuated, undivided, and closed at the apex.*

Obs. None of the shells of this genus were known to Linnæus. Mr Boys discovered the *C. Imperforatum*, which was inserted by Mr Walker in the genus Dentalium, without sufficient consideration, as one of the characters of that genus, "*utraque extremitate pervia*," forbade its admission. The impervious apex, and cylindrical form of the Imperforatum, and two others lately discovered, point out the propriety of constituting a new genus for their reception.

Imperforatum, 1. *Imperforatum.* Shell cylindric, subarcuated, striated transversely; aperture a little contracted at the margin; apex truncated, and furnished with a small round protuberance; length one-eighth of an inch, breadth one-third of its length.

Walker's *Minute Shells*, fig. 15. Dentalium.

Found by Mr Boys at Sandwich, and by Mr Montagu at Falmouth.

Trachea, 2. *Trachea.* Subcylindric, subarcuated, with regular, strong, transverse striæ; aperture round; apex truncated, and furnished with a small round protuberance; length about one-eighth of an inch, the diameter about one-fifth of its length.

Test. Brit. p. 497. tab. 14. fig. 10. Dentalium Trachea.

Discovered by Mr Montagu in sand from Milton, Devonshire.

Glabrum. 3. *Glabrum.* Shell cylindric, arcuated, smooth, glossy; mouth orbicular; apex rounded and submarginated; length one line.

Test. Brit. p. 497. Dentalium glabrum.

Discovered by Mr Montagu in Biddeford Bay, and at Barnstable, Devonshire; Capt. Laskey has observed it at Dunbar; and we have found it in Zetland

Genus VI. Serpula.

VI. Serpula. *Shell tubular, flexuous, contorted, adhering to other bodies.*

Obs. The inhabitants of this genus of shells belong to the class Annelides of Latreille, and may with propriety be divided into several genera. Their history is still involved in much obscurity.

Vermicularis, 1. *Vermicularis.* Shell round, opake, flexuous, tapering to a fine point, wrinkled transversely, and attached throughout its whole length to other bodies. Diameter sometimes as large as a swan's quill; length from three to four inches.

Brit. Zool tab. 91. fig. 158.

Pult. *Hush. Dorset.* tab. 22. fig. 9.

This is a common shell, adhering to stones, old shells, and corals. It is subject to considerable variation in its shape. The Serpula Intricata of Linnæus may be referred to this species.

The annimal resembles a *Terebella.* It is furnished with branched ciliated tentacula, which are spotted with crimson, and when extended, almost surround a double funnel-shaped proboscis.

Triquetra, 2. *Triquetra.* Shell strong, white, opake, contorted, wrinkled transversely, base spreading, back furnished with a keel or ridge. Diameter one-tenth of an inch.

Brit. Zool. tab. 91. fig. 157. S. Contortuplicata.

Brit. Shells, tab. 95. S. Vermicularis, exclusive of the middle and right hand figures.

This shell is very common, adhering to shells and stones, or twisted round the stalks of fuci. It varies much in shape, being sometimes nearly destitute of any dorsal ridge, and occasionally furnished with two small lateral ridges.

The inhabitant, as described by Mr Montagu, and figured by Ellis, (*Corallines*, tab. 38. fig. 2.), possesses two tentacula, which are plumose, or furnished with numerous ciliated fibres, varying in colour, being barred with blue, yellow, brown, or red. The trumpet-shaped proboscis is finely striated, and the margin crenated.

Mr Montagu likewise found four other animals inhabiting shells of similar form, as the triquetra, yet different from the one which is now described. 1. With a smooth and slightly concave *testaceous* termination or operculum. 2. With a testaceous termination, armed with two or three spines in front. 3. With a testaceous conical termination. 4. With a smooth termination, grooved on each side for the reception of two *cirri* placed at the base of the operculum, which is corneous, and furnished with a bifid stile.

Serrulata, 3. *Serrulata.* Shell transparent, smooth, glossy, triangular, tapering, flexuous, base spreading, adhering; dorsal ridge serrated, and a little produced at the opening. Breadth at the base two-tenths of an inch, length about three inches.

This new species was found in Zetland in 1809, adhering to stones brought from deep water, to which it is attached throughout. Its transparency and lustre, independent of other characters, entitle it to a separate place in the system.

Tubularia, 4. *Tubularia.* Shell white, opake, round, tapering, slightly wrinkled transversely, adhering at the smaller end, and irregularly flexuous. Diameter two-tenths of an inch, length seven inches.

Test. Brit. p. 513.

It was first observed at Torcross, Devonshire, by Mr Montagu. It is found in Zetland, along with the preceding species.

Mr Montagu observes, that the animal is an amphitrite, with between fifty and sixty annulations. The head is long, white, and barred with green, having a loose scalloped dilatable membrane on each side. Tentacula two, beautifully feathered, each originating from a single stalk, and placed near to each other, on the forepart of the head.

Family III. FLASK-SHAPED.

The shells included in this family were unknown to Linnæus. They are furnished with a one-celled cavity, are destitute of a spire, and in shape resemble a bottle or flask. The family contains only one genus, which is denominated Lagena.

Univalves.

Genus VII. Lagena.

VII. Lagena. *Shell Bottle-shaped, not attached to other bodies.*

Obs. We are indebted to Mr Walker for the information which we possess concerning the species of this genus. They were termed by him Lagena, but unaccountably referred to the Linnæan genus of Serpula. In *Testacea Britannica,* they are included in the genus Vermiculum. All those species which are at present known, require the aid of the microscope for their examination.

Striata, 1. *Striata.* Shell pellucid, glossy, white, with opake longitudinal striæ, suboval; mouth produced, tubular, small; length about half a line.

Walker's *Test. Min. Rar.* tab. 1. fig. 6.

Among sand on the English shores, not uncommon.

Globosa, 2. *Globosa.* Shell white, transparent, smooth, subovate; mouth small and round.

Walker's *Test. Min. Rar.* tab. 1. fig. 8.

Found at Sandwich, rare.

Lævis, 3. *Lævis.* Shell bluish white, transparent, smooth, oblong; mouth produced cylindrical.

Walker's *Test. Min. Rar.* tab. 1. fig. 9.

From Sandwich, rare.

Marginata, 4. *Marginata.* Shell white, transparent, glossy, subovate, subcompressed, margin elevated; mouth a little produced.

Walker's *Test. Min. Rar.* tab. 1. fig. 7.

Found at Reculver, Kent, by Mr Walker, and on the coast of Devon by Mr Montagu.

Retorta, 5. *Retorta.* Shell white, opake, suborbicular, margin elevated; mouth produced recurved; diameter not half a line.

Walker's *Test. Min. Rar.* tab. 1. fig. 10.

From Sandwich, rare.

Perlucida, 6. *Perlucida.* Shell white, transparent, glossy, globubular, with six equidistant longitudinal ribs, and a small knob at the base; neck produced, mouth small; length one-tenth of an inch.

Test. Brit. tab. 14. fig. 3.

Found at Sea Salter, Kent, by Mr Boys.

Urnæ, 7. *Urnæ.* Shell white, semitransparent, glossy, smooth, urn-shaped, base furnished with a knob, mouth produced, neck conical; length one line.

Test. Brit. tab. 14. fig. 1.

Found by Mr Boys among sand from Sheppey island.

Squamosa. 8. *Squamosa.* Shell globose, mouth a little produced, striated, the striæ appearing like the scales of a fish.

Test. Brit. tab. 14. fig. 2.

A minute species, found at Sea Salter by Mr Boys.

Family IV. SPIRAL.

In this division of shells, are included such spiral univalves as are destitute of a pillar, and whose whorls or volutions are placed laterally, so that the last whorl is on the outside forming the Margin. The family possesses two genera, Spirorbis and Planorbis.

Genus VIII. Spirorbis.

VIII. Spirorbis. *Shell spiral, aperture orbicular, base adhering to other bodies.*

Obs. The species of this genus live in the sea, and adhere to rocks, old shells, sea-weed, and corals. They were included by Linnæus in his genus Serpula. The inhabitants belong to the class *Annelides* of Latreille. The genus admits of two subdivisions.

A. Mouth Dextral.

Communis, 1. *Communis.* Shell opake, with three or four regular lateral whirls, round on the upper part, and a little wrinkled, with a cavity in the centre, base spreading, diameter one eighth of an inch.

Serpula spirorbis. *Brit. Zool.* tab. 91. fig. 155.

Donov. *Brit. Sh.* tab. 9.

Animal furnished with branched ciliated tentacula, and a clavate or subfunnel shaped proboscis. Common on stones, shells, and algæ.

Spirilium, 2. *Spirilium.* Shell white, glossy, subpellucid, with two or three subcylindrical whorls a little wrinkled, sometimes placed laterally, and often rising one above the other; diameter one line.

Pultney, *Hist. Dor.* tab. 19. fig. 27.

This species usually resides on Algæ; and, although it resembles in appearance the former species, is never found in its company.

Granulatus, 3. *Granulatus.* Shell white, opake, with two volutions deeply grooved longitudinally, and wrinkled transversely, size of the *Spirorbis.*

Donovan, *Brit. Sh.* tab. 100.

Animal of a buff colour, with ten ciliated rays. Found on stones and old shells.

Carinatus, 4. *Carinatus.* Shell white, opake, dull, outer whorl rising into a carinated ridge on the top, middle concave, interior volution inconspicuous, base a little spreading.

Test. Brit. p. 502.

Adheres to old shells. Common to England and Scotland.

Corrugatus, 5. *Corrugatus.* Shell white, glossy, strong, transversely wrinkled, a small portion only of the second volution visible, centre with a cavity; diameter about one-eighth of an inch.

Test. Brit. p. 502.

Animal orange red, with eight greenish ciliated rays, and a subfunnel shaped proboscis of the same colour. Found on slate rocks at Milton, by Mr Montagu.

Corneus, 6. *Corneus.* Shell horn coloured, regular, round, with three whirls.

Lin. trans. v. tab. 1. fig. 33, 34, 35.

Found at Pembroke, by Mr Adams.

B. Mouth Sinistral.

Heterostrophus, 7. *Heterostrophus.* Shell white, dull, strong, with two or three whorls placed laterally, furnished with three longitudinal ridges, wrinkled transversely, base flat; spreading; diameter a line.

Test. Brit. p. 503.

Found on stones, shells, any algæ, common.

Sinistrorsus, 8. *Sinistrorsus.* Shell white, glossy, semipellucid, with two or three lateral whorls frequently coiled upon one another, and slightly wrinkled transversely; diameter a line.

Walker's *Test. Min. Rar.* tab. 1. fig. 13, 14.

Usually found on lobsters; we have observed it on old shells of *Cardium aculeatum.*

Minutus, 9. *Minutus.* Shell dirty white, with two or three lateral whorls, wrinkled transversely, and sometimes furnished with a dorsal carina, base rounded; diameter a quarter of a line.

Test. Brit. p. 505.

Animal with ciliated feelers and a clavate proboscis. Inhabits the branches of *Corallina officinalis.*

Conicus, 10. *Conicus.* Shell dirty white, dull, opake, whirls two, the outer one large, and embracing the other, with a carina along the upper side, conical, mouth towards the top.

In a young state, it resembles the preceding species;

Univalves. when old it becomes conical. Found on old shells in Zetland.

Lucidus, 11. *Lucidus.* Shell white, glossy, pellucid, irregular, whorls two or three, sometimes lateral, and often projecting upwards and unconnected, diameter half a line.

Test. Brit. p. 506.

Animal red, with plumose tentacula of a pale colour, and two brown spots on the head. Frequent on corallines, especially *Sertularia abietina.*

Reversus. 12. *Reversus.* Shell white, rugose, subcylindric, subspiral, tapering to a small point; diameter at the larger end one-tenth of an inch.

Test. Brit. p. 508.

Found on *Pecten opercularis,* on the coast of Devon, by Mr Montague.

Genus IX. Planorbis.

IX. Planorbis. *Shell simple spiral depressed, spires lateral, mouth oblique.*

Obs. The species of this genus were included among the Helices by Linnæus. The continental naturalists have long ago separated them, and constituted the present genus. They possess many characters in common. They are all of a horn colour, subpellucid, and the mouth is placed obliquely to the direction of the whirls. They inhabit fresh water ditches, ponds, and rivers. The base of these shells is known by its being more sunk in than the upper side, and, from the gradual diminution of the whorls towards the centre, forming a funnel-shaped cavity.

Corneus, 1. *Corneus.* Shell brownish coloured, subpellucid, whorls four, rounded, separated by a deep spiral line, apex much depressed, forming a cavity, underside a little concave, wrinkled transversely; mouth sublunated; diameter an inch and quarter.

Brit. Zool. tab. 83. fig. 26. H. corneus.
Brit. Shells, tab. 39. fig. 1.

Common in England, in ditches, and old drains.

Complanatus. 2. *Complanatus.* Shell with five whorls gradually dcereasing to the centre, rounded, separated by a deep spiral line, wrinkled transversely, margin carinated, terminating at the inferior angle of the mouth, diameter five-eighths of an inch.

Test. Brit. tab. 25. fig. 4. Helix complanatus.
Brit. Zool. tab. 82. fig. 123. H. planorbis.

Animal dusky, with two long slender setaceous tentacula of the same colour, opake, dark in the middle. Common in ditches, in England and near Edinburgh.

Carinatus. 3. *Carinatus.* Shell a little glossy, whorls four, wrinkled across, outer one broad, sloping to a carina on both sides, which enters the mouth, the inner whirls decrease suddenly to the centre, where is a small cavity, base nearly flat, diameter about three-fourths of an inch.

Lin. *Syst.* Helix planorbis.
Test. Brit. tab. 25. fig. 1.
Lin. Trans. vol. viii. tab. 5. fig. 14.

The animal differs from the preceding species in the tentacula, being somewhat longer, pellucid, yellow, and not darker in the middle. In ditches and ponds, in England frequent, and near Edinburgh.

Vortex, 4. *Vortex.* Shell with six or seven whirls, above concave, beneath flat, even, marked with a fine separating line, exterior whorl subcarinated at the lower edge, diameter scarcely half an inch.

Test. Brit. tab. 25. fig. 3.
Brit. Zool. tab. 83. fig. 124.
Brit. Shells, tab. 75.

Anima dusky, with two long filiform tentacula, and two black eyes placed at their base. Common in England, in ponds and ditches. Univalves.

Spirorbis, 5. *Spirorbis.* Shell with six whorls exactly lateral, round, both sides flat; diameter three-tenths of an inch.

Test. Brit. tab. 25. fig. 2.

In rivers and ditches, England, and at Livingstone, West-Lothian.

Contortus, 6. *Contortus.* Shell with five or six whorls, the outer one rounded; above even, the whirls divided by a separating line, with a cavity in the centre; beneath with a large central cavity; mouth bent, embracing the body whorl; diameter about one-tenth of an inch.

Test. Brit. tab. 25. fig. 6.
Brit. Shells, tab. 99.

Animal dusky, with two long filiform tentacula, with the eyes placed at their base. In ditches in England, rather a local species, and near Edinburgh and Cupar.

Albus, 7. *Albus.* Shell with four lateral compressed whorls, the outer one subcarinated; above the apex a little depressed; beneath it is furnished with a cavity; striated transversely and longitudinally; mouth clasping the body whorl; diameter a quarter of an inch.

Test. Brit. tab. 25. fig. 7.
Pult. Dorset. tab. 19. fig. 18.

Animal light coloured, with two long filiform tentacula, with two eyes at their base on the top of the head. Frequent in rivers and ponds in England; found also at Dunbar, by Mr Laskey.

Cristatus, 8. *Cristatus.* Shell with three or four rounded whirls striated transversely; above, the apex is little sunk, beneath there is a cavity; aperture orbicular; diameter one-tenth of an inch.

Test. Min. Rar. tab. 1. fig. 18.
Test. Brit. vignette 1. fig. 7, 8.

Animal dusky, with four tentacula, and a plumose appendage, the body lobated in front. In England rare.

Fontanus, 9. *Fontanus.* Shell smooth, glossy, nearly equal on both sides, above, subdepressed, the cavity beneath, large and exhibiting the volutions; whorls four, the outer one subcarinated; diameter two-tenths.

Test. Brit. tab. 6. fig. 6.

Animal light chesnut, with two filiform tentacula, head long. Frequent in England, has been found at Cupar.

Nautileus. 10. *Nautileus.* Shell with four whorls, ribbed across, with a subspinous carina, above flat, beneath with a large cavity; diameter one-eighth of an inch.

Test. Min. Rar. tab. 1. fig. 20, 21.
Test. Brit. tab. 25. fig. 5.

Animal of a pale colour, tentacula, two setaceous; eyes on the head at the base of the tentacula. In ponds and ditches, in England frequent.

SECT. II. STULIDIA.

Stulidia. The shells included in this Section are all of them more or less spiral and revolve round a central pillar, or columella, as it is sometimes called. The genera of this Section admit of distribution into three families, Turreted, Globose, and Convoluted.

Family I. TURRETED.

The shells of this family have their whorls much produced above, and are of a lengthened conical form. The length of the shell usually exceeding greatly the breadth of it. This family includes six genera, Buccinum, Murex, Strombus, Turbo, Odostomia, and Lymnæa. These genera admit of distribution into two tribes,

Univalves.

the Canaliculated and the Entire; the three first belong to the former, and the remaining genera to the latter.

Tribe 1. *Canaliculated.*

In shells of this tribe, the mouth at the base terminates in a grooved beak, more or less produced. The tribe contains three genera, Buccinum, Murex, and Strombus, which, in many respects, are nearly allied to one another.

GENUS X. BUCCINUM.

X. Buccinum. *Shell spiral, gibbous; produced, aperture ovate, ending in a short canal leaning to the right; pillar lip expanding.*

Undatum, 1. *Undatum.* Shell with seven or eight ventricose spires, with waved ribs, striated transversely and longitudinally, strong, sometimes five inches in length.

Brit. Zool. tab. 73, 74.

In its young state, this shell has an obtuse globular apex, and has been described as a distinct species by some authors. Common on all our shores.

Glaciale, 2. *Glaciale.* Shell tapering, livid brown, with about nine spirally striated volutions, the top of each spire furnished with waved ribs; body whorl usually furnished with a small ridge or keel; aperture ovate, outer lip thin, spreading; length about two inches.

Brit. Shells, tab. 154.

Found by Mr Agnew among the Orkney Isles.

Lapillus, 3. *Lapillus.* Shell thick, with five or six strongly striated spires; outer lip waved, or subdenticulated; pillar lip smooth, replicated; length seldom above two inches.

Brit. Zool. tab. 72. fig. 89.
Brit. Shells, tab. 11.

This species varies in appearance in different stages of its growth. It is placed by Lamark in his genus *Purpura.* It is common on the rocks on every part of the coast. The animal yields an unchangeable crimson dye.

Reticulatum, 4. *Reticulatum.* Shell with seven or eight ribbed spires, tapering to a fine point, wrinkled across, decussated; aperture suboval; outer lip even, denticulated within; length about an inch and a half.

Brit. Zool. tab. 72. fig. 92.
Brit. Shells, tab. 76.

Not uncommon in England and Scotland.

Macula, 5. *Macula.* Shell with six or seven ribbed spires, transversely striated; apex pointed; mouth suborbicular; outer lip globose at the back; denticulated within; inner lip replicated, and faintly denticulated; outer edge of the canal purplish; length about half an inch, breadth a quarter.

Test. Brit. tab. 8. fig. 4.

Common on the coasts of England and Scotland.

Ambiguum, 6. *Ambiguum.* Shell subconical, faintly striated transversely, with six to fifteen ribs; mouth suborbicular; outer lip thickened, slightly denticulate; inner lip folded back; length about half an inch.

Test. Brit. tab. 9. fig. 7.

Not frequent; found at Weymouth and Portland.

Hepaticum, 7. *Hepaticum.* Shell brownish, with seven or eight ribbed volutions, a transverse depression near the top of each of the spires, which are tumid, and strongly divided; apex sharp; outer lip thick, turning inwards to an edge; inner lip folded back; about an inch in length.

Test. Brit. tab. 8. fig. 1.

Found at Purbeck and at Weymouth, by Dr Pulteney.

Bilineatum. 8. *Bilineatum.* Shell ovate, smooth, girded with two to four bands of brown spots, the upper part set round with two series of tubercles; mouth large, suboval; outer lip slightly dentated, inner lip rugose and granulated.

Brit. Zool. App. tab. 79. bottom figures.

Found at Weymouth by Mr Pennant.

Perdix, 9. *Perdix.* Shell suboval, with five or six volutions, the first large and tumid, the others small in proportion, marked with small transverse ridges; mouth large oval, outer lip thin plain.

Test. Brit. tab. 8. fig. 5.

Found at Weymouth by Dr Pulteney and Mr Bryer, and on Iona by Mr Laskey.

Lineatum, 10. *Lineatum.* Shell smooth conical, with five or six spires, regularly banded with alternate spiral lines of brown and white; apex pointed; mouth oval; length a quarter of an inch, breadth one-eighth.

Brit. Shells, tab. 15.

On the English shores; rare.

Cinctum, 11. *Cinctum.* Shell white conical, marked with a fine thread-like girdle of a rufous brown colour round the middle of each spire, volutions six or seven, nearly even, finely and closely ribbed, obsoletely striated across; apex sharp; mouth narrow, outer lip thick, toothed within; length scarcely a quarter of an inch.

Test. Brit. tab. 15. fig. 1.

Found by Mr Bryer on the shore near Weymouth.

Minimum, 12. *Minimum.* Shell with fine reticulated taper spires, mouth oval, both lips smooth; length about two-tenths of an inch.

Test. Brit. tab. 8. fig. 2.

Found on the coast of Devon by Mr Montagu, and at Dunbar by Mr Laskey.

Terrestre, 13. *Terrestre.* Shell with six slender smooth white spires, terminating in an obtuse point; mouth oblong suboval, outer lip thin, even, pillar lip thickened; length nearly a quarter of an inch.

Test. Brit. tab. 8. fig. 3.

Found in England, rare; at Dunbar by Mr Laskey.

Obtusulum, 14. *Obtusulum.* Shell with three bellied spires, and an oval aperture, opake, white.

Test. Min. Rar. tab. 2. fig. 59.

A microscopic species found at Feversham creek by Mr Walker.

Breve, 15. *Breve.* Shell white, opake, short, with fine whorls, longitudinally ribbed, and transversely striated.

Lin. Trans. vol. iii. tab. 13. fig. 3. 4.

Minutum, 16. *Minutum.* Shell white, opake, with three longitudinally ribbed whorls.

Lin. Trans. vol. iii. tab. 13. fig. 5. 6.

Læve, 17. *Læve.* Shell white, opake, mouth oval, spires three, smooth, the first ventricose.

Lin. Trans. vol. iii. tab. 13. fig. 7. 8.

Obtusissimum. 18. *Obtusissimum.* Shell white, with three smooth spires, mouth contracted.

Lin. Trans. vol. iii. tab. 13. fig. 9. 10.

The four preceding species were found on the coast of Pembrokeshire by Mr Adams.

GENUS XI. MUREX.

XI. Murex. *Shell spiral, rough, with membranaceous folds; mouth*

Univalves. *oval, ending in an entire straight or slightly ascending canal.*

Obs. This genus is nearly allied to the former, and is principally distinguished from it by the greater length of the canal. We have, for the present, formed this genus into three families.

A. Canal short, spires furnished with foliated tubercles.

Erinaceus, 1. *Erinaceus.* Shell strong angulated, with six or seven spires, terminating in a fine point; each volution is furnished with six or seven rugged prominent longitudinal ribs; canal tubular; length an inch and three quarters, and nearly an inch wide.

Brit. Zool. tab. 76. fig. 95.

Brit. Shells, tab. 35.

Frequent on the English and Scottish shores.

B. Canal short, shell tapering.

Subulatus, 2. *Subulatus.* Shell slender, white, with about fifteen spires a little elevated, defined by a purplish brown line, each wrought with two rows of beads divided by a depressed line; mouth small, canal short, and turning to the left; base smooth; length three-eighths of an inch.

Test. Brit tab. 30. fig. 6.

Found amongst sea-sand in the sound of Mull

Fuscatus, 3. *Fuscatus.* Shell with ten or twelve tuberculated spires, tapering to a fine point; volutions wrought with three or four series of crenulated striæ between the tuberculated spiral ridges; mouth small, oval, ending in a slight canal.

Brit. Zool. tab. 83. fig. 3.

Found by Mr Pennant on the coast of Northumberland, by Mr Bryer at Weymouth, and by Mr Laskey at Jura.

Reticulatus, 4. *Reticulatus.* Shell with eleven or twelve reticulated volutions, strong, slender, tapering, four spiral ridges on each volution, crossed with longitudinal furrows; mouth oval, angulated at the upper part; length five-eighths of an inch.

Pult. *Dorset.* tab. 14. fig. 13.

Not uncommon on the English coast, also on the west coast of Scotland.

Tubercularis, 5. *Tubercularis.* Shell with nine or ten slender, taper, tuberculated spires, separated only by a slight depression, with three series of tubercles of equal size on each volution; length a quarter of an inch.

Test. Brit. p. 270.

Found in Devonshire by Mr Montagu, at Sandwich by Mr Boys, and at Dunbar by Mr Laskey.

Adversus, 6. *Adversus.* Spires sinistral, tuberculated, tapering to a fine point; volutions scarcely defined by the separating line, with three series of tubercles on each; mouth oval; ending in a straight canal; length three-eighths of an inch.

Test. Min. Rar. tab. 2. fig. 48.

Brit. Shells, tab. 15.

Found by Mr Walker at Sandwich, Miss Pocock in Cornwall, Mr Montagu in Devon, and by Mr Laskey at Dunbar.

C. Canal produced.

Gracilis, 7. *Gracilis.* Shell with thirteen ribs, purplish brown at the junction of the spires, with a white band round the middle of the body whorl; volutions with twelve ribs, separated at the juncture of each spire by a flat space, striated across.

Test. Brit. tab. 15. fig. 5.

Found at Biddeford Bay by Mr Montagu, at Portland by Mr Bryer, and at Dunbar by Mr Laskey.

8. *Accinctus.* Shell with six or seven costated volutions; the ribs are slightly angulated; whorls with spiral striæ; canal short; lip entire at the upper angle; length four lines. Accinctus,

Mem. Wernerian Soc. vol. i. tab. 8. fig. 14.

In the Frith of Forth by Mr Laskey.

9. *Attenuatus.* Shell with eight spires, destitute of striæ, and furnished with nine strong equidistant ribs; volutions scarcely raised; mouth narrow; outer lip thickened at the back with a rib, inner lip plain; length half an inch. Attenuatus,

Test. Brit. tab. 9. fig. 6.

Found at Falmouth harbour and Biddeford bay by Mr Montagu.

10. *Nebula.* Shell with eight taper costated spires, terminating in a sharp point, finely reticulated; volutions scarcely separated; mouth narrow, oblong; outer lip sharp, inner lip replicate; upwards of half an inch in length. Nebula.

Test. Brit. tab. 15. fig. 6.

Found by Mr Montagu on the English coast.

11. *Costatus.* Shell with six taper volutions; with eight or nine elevated ribs, without striæ; mouth narrow; outer lip usually thickened by a rib at the back, margin thin; length three-tenths of an inch. Costatus,

Brit. Shells, tab. 91.

On the English coast not common, Mr Laskey has found it at Dunbar, and we have it from Zetland.

12. *Proximus.* Shell thick, white, with six strongly costated spires; apex moderately pointed; mouth ovate, oblong; outer lip broad, reflexed; canal short, and rather spreading at the end; length about half an inch. Proximus,

Test. Brit. tab. 30. fig. 8.

Found by Mr Laskey at Dunbar.

13. *Septangularis.* Shell with eight strong, smooth, taper whorls, with seven longitudinal ridges, that run the whole length of the shell; mouth oblong, oval; outer lip sharp at the edge; length five-eighths of an inch. Septangularis,

Brit. Shells, tab. 179. fig. 4.

Test Brit. tab. 9. fig. 5.

Found at Falmouth and Salcomb bay by Mr Montagu, and at Weymouth by Mr Bryer.

14. *Turricula.* Shell with seven taper ribbed spires terminating in a fine point, and striated transversely; volutions rise perpendicularly above one another, the top of each being almost flat, and the ribs at that part are angulated; mouth narrow; length three quarters of an inch. Turricula.

Test. Brit. tab. 9. fig. 1.

In England and Scotland not uncommon.

15. *Rufus.* Shell with six taper-ribbed spires of a pale rufous brown colour; whorls furnished with about sixteen small ribs striated across; mouth narrow; canal short; pillar lip smooth; outer lip smooth, rarely thickened by a rib; length three-tenths of an inch. Rufus,

Test. Brit. p. 263.

On the English shores by Mr Montagu, at Dunbar by Mr Laskey.

16. *Gyrinus.* Shell strong, short, conic, with four brown whorls regularly covered with dark chesnut coloured tubercles, eight in a row on the body whorl, and three on the succeeding volution; length about a quarter of an inch. Gyrinus,

2

Univalves.

Mem. Wer. Soc. vol. i. tab. 8. fig. 10.

Sinuosus, 17. *Sinuosus.* Shell with six spires and six or seven ribs on each, striated across; volutions little raised; at the upper angle of the mouth a deep sinus; outer lip slightly thickened by a rib; length three quarters of an inch.

Test. Brit. tab. 9. fig. 8.

Found at Weymouth by Mr Bryer, and at Dunbar by Mr Laskey.

Antiquus, 18. *Antiquus.* Shell thick, strong, with eight whorls, ventricose; faintly striated longitudinally and transversely; mouth sub-oval; outer lip plain; inner lip replicated; inside yellowish; length about six inches.

Brit. Zool. tab. 78.

Brit. Shells, tab. 31.

Common on the British shores. It is used in Zetland as a lamp, the canal serves to hold the wick, the cavity contains the oil and the shell is suspended horizontally by a cord.

Subantiquatus, 19. *Subantiquatus.* Shell with eight whorls, striated transversely, and obsoletely ribbed longitudinally, the middle of each volution rising into a strong undulated carniated ridge, sometimes two; mouth oval; canal long; outer lip even; length three inches and a half.

Brit. Shells, tab. 119.

Said to have been found on the Scottish coast.

Carinatus, 20. *Carinatus.* Shell oblong of six spires, with two smooth spiral ridges; first whorl ventricose, aperture semicircular; length nearly four inches.

Brit. Zool. tab. 77.

Brit. Shells, tab. 109.

First figured and described by Mr Pennant, from the Portland cabinet; it has since been found by Mr Laskey at Dunbar.

Corneus, 21. *Corneus.* Shell with eight strong taper spires, transversely striated, and wrinkled longitudinally; whorls round, divided by a strong separating line; mouth oval; canal long, a little reflected; length three inches.

Brit. Zool. tab. 76. fig. 99.

Brit. Shells, tab. 38.

Common on the British shores.

Linearis, 22. *Linearis.* Shell rugose, with eight rounded and strongly ribbed whorls, crossed by elevated striæ, the summits of which are purplish brown; mouth oval; outer lip thickened at the back with a rib, crenated within; pillar lip smooth; length a quarter of an inch.

Test. Brit. tab. 9. fig. 4.

Brit. Shells, tab. 179. fig. 3.

Frequent on the English coast, found also at Dunbar by Mr Laskey.

Purpureus, 23. *Purpureus.* Shell rugose, of a dark purple colour, with spots of white, whorls ten, rounded, tapering, furnished with twenty oblique ribs, crossed by sharp ridges, mouth narrow, columella striated; length five-eighths of an inch.

Test. Brit. tab. 9. fig. 2.

On the coast of Devon by Mr Montague, and in Leith Roads by Mr Laskey.

Muricatus, 24. *Muricatus.* Shell strong, rough, with six or seven ventricose tuberculated volutions, tapering to a fine point; mouth oval, terminating in a long slender canal, outer lip dentated at the edge; length half an inch.

Test. Brit. tab. 9. fig. 2.

Found in Salcomb Bay by Mr Montagu, and at Dunbar by Mr Laskey.

Bamfius, 25. *Bamfius.* Shell ventricose, white, ribbed longitudinally, with acute plaits; mouth ovate; canal turning a little to the left; length about three-quarters of an inch. Univalves.

Brit. Shells, tab. 169, fig. 2.

Frequent on the Scottish coast, where it was first observed by the Rev. Mr Cordiner at Banff.

26. *Minutissimus.* Shell with fine spirally striated whorls, and remote ribs; canal closed. Minutissimus.

Lin. Trans. vol. iii. p. 65.

A minute species, found at Pembroke by Mr Adams.

Genus XII. Strombus.

Shell spiral, aperture much dilated, lip expanding, and produced into a groove, leaning to the left. XII. Strombus.

Obs. Young shells of this genus nearly resemble the species of the genus Murex, being destitute of the expansion of the outer lip.

1. *Pes Pelecani.* Shell pyramidal, with ten tuberculated whorls; outer lip expanded and quadrifid; canal produced; length about two inches. Pes Pelecani,

Brit. Zool. tab. 75.

Brit. Shells, tab. 4.

Common on the British shores.

2. *Costatus.* Shell with eleven dark brown volutions, tapering to a fine point, with close set ribs, and an elevated spiral line; mouth suborbicular, outer lip a little expanded, inner lip smooth, with a subcanal; length scarcely half an inch. Costatus.

Brit. Shells, tab. 94.

Test. Brit. tab. 30, fig. 7.

In England rare; at the Sound of Iona Mr Laskey; and we have found it at St Andrews.

Tribe 2. Entire.

In this tribe, the base of the aperture is entire, and not produced and grooved, as in the former. It contains three genera, *Turbo, Odostomia,* and *Lymnæa.*

Genus XIII. Turbo.

Shell spiral, produced, mouth contracted, orbicular, entire. XIII. Turbo.

A. Imperforate, first whorl ventricose; pillar-margin of the mouth dilated.

1. *Littoreus.* Shell strong with five whorls, first large, others nearly flat; outer lip thin, inner lip thick and strong; length about an inch. Littoreus,

Brit. Shells, tab. 33. fig. 1.

Animal striped with black; tentacula two, setaceous, annulated, with eyes at the base. Common on marine rocks.

2. *Tenebrosus.* Shell conical, with five ventricose spires; apex obtusely pointed; outer lip thin, spreading a little at the lower angle; diameter about a quarter of an inch. Tenebrosus,

Test. Brit. page 303.

Found on the English coast by Mr Montagu.

3. *Rudis.* Shell strong, with five ventricose whorls, well defined by the separating line, and sometimes spirally striated; inner lip thick, a little reflected; colour, yellow or brown; length three quarters of an inch. Rudis.

Brit. Shells, tab. 33. fig. 3.

Animal yellowish, with two setaceous tentacula of the same colour, most commonly marked with a longitudinal dusky streak on the outside. Not uncommon.

4. *Striatulus.* Shell with five volutions, each terminated in a flat top; base wrought with spiral striæ, which, towards the upper part, rise into three elevated Striatulus,

Univalves. membranaceous ridges; mouth angulated at the upper part; length two-tenths of an inch.

Test. Brit. tab. 10, fig. 5.

Found in Cornwall, Falmouth, and the coast of South Devon.

Jugosus, 5. *Jugosus.* Shell with four spirally ridged whorls, the first very large, occupying three-fourths of the shell; outer lip thin, sub-crenated at the edges; pillar lip broad and smooth; diameter scarcely half an inch.

Test. Brit. tab. 20, fig. 2.

Lin. Trans. vol. viii. tab. 4, fig. 7.

Found by Mr Knight in Dorset, by Mr Gibbs in Cornwall, and by Mr Laskey at Dunbar.

Mammillatus, 6. *Mammillatus.* Shell imperforate, subovate, whorls striated with raised dots and slightly angulated by a few of these striæ, the dots of which are larger.

Brit. Shells, tab. 173.

Found by Mr Plat on the Scilly rocks, at the western extremity of Cornwall, and communicated by him to Da Costa.

B. Imperforate, long, tapering.

Terebra, 7. *Terebra.* Shell with about sixteen volutions, terminating in a very fine point; larger whorls, somewhat rounded, and marked with spiral striæ; outer lip thin, fragile and semipellucid; length about two inches; breadth at the base, five-eighths.

Brit. Zool. tab. 81, fig. 113.

Animal yellowish, striped with dusky; tentacula two, short, with the eyes placed at the base. Common.

Cinctus, 8. *Cinctus.* Shell with fourteen raised volutions, separated by a deep depression, wrought with obsolete spiral striæ, with two strong elevated ridges in the middle of each volution, covered with undulated coloured lines; length two inches and a half; breadth, at the base, five-eighths of an inch.

Brit. Shells, tab. 22, fig. 1.

On the English coast, not common.

Nitidissimus, 9. *Nitidissimus.* Shell with nine extremely slender, smooth, pellucid, white spires, terminating in a fine point; the volutions are greatly raised and much rounded, and separated by a deep depression; aperture sub-orbicular; inner lip a little reflected; length one-eighth of an inch.

Test. Brit. tab. 12, fig. 1.

Found at Falmouth harbour by Mr Montagu.

Subtruncatus, 10. *Subtruncatus.* Shell with seven rounded smooth whorls, separated by a deep depressed line; colour pellucid yellowish white; length two tenths of an inch.

Test. Brit. tab. 10, fig. 1.

Found by Mr Montagu at Southampton and Falmouth; by Mr Laskey at Dunbar.

Truncatus, 11. *Truncatus.* Shell cylindric, smooth, glossy, horn-coloured, with four spires, apex abrupt; volutions considerably raised, aperture slightly emarginated; length two-tenths of an inch.

Test. Brit. tab. 10, fig. 7.

On the English coast frequent; has also been taken at Dunbar by Mr Laskey.

C. Furnished with ridges crossing the whorls.

Clathrus, 12. *Clathrus.* Shell with twelve taper spires, volutions rounded, barred the whole length of the shell with from nine to twelve regular distant membranaceous ribs; margin of the mouth thickened by a rib that surrounds it; length an inch and a half; breadth at the base half an inch.

Brit. Zool. tab. 81. fig. 111.

Animal with a long tubular proboscis, slender tentacula, and a white sustentaculum. On the British shores, not uncommon.

Clathratulus, 13. *Clathratulus.* Shell with six volutions, ribbed across with fifteen ridges; nearly resembles the preceding, but is more slender; length about half an inch.

Test. Min. Rar. tab. 2. fig. 45.

On the British shores.

Unicus, 14. *Unicus.* Shell with nine, slender, glossy, pellucid, white spires, terminating in a fine point, longitudinal ridges undulated, transversely striated; length two-tenths of an inch.

Test. Brit. tab. 12. fig. 2.

First noticed at Sandwich by Mr Boys.

Parvus, 15. *Parvus.* Shell strong, conic, with five or six coarsely ribbed volutions; colour various; outer lip thickened by a rib; length one eighth of an inch.

Brit. Shells, tab. 90.

On the English and Scottish coasts, not uncommon.

Costatus, 16. *Costatus.* Shell strong, white, with four or five whorls; ribs strong, and striated transversely; lip a little expanded; length nearly one-eighth of an inch; breadth one-third of its length.

Test. Brit. tab. 10. fig. 6.

On the English shores not uncommon; also at Dunbar.

Striatus, 17. *Striatus.* Shell pellucid, glossy, white, with six volutions, somewhat rounded and separated by a well defined line; upper part of each volution faintly ribbed, the whole shell regularly striated transversely; mouth marginated; length one-eighth of an inch.

Test. Min. Rar. tab. 2, fig. 49.

Common on the British shores from Devonshire to Zetland.

Bryereus, 18. *Bryereus.* Shell conic, glossy, white, with seven smooth spires, finely costated with about eighteen ribs; outer lip strong, pillar lip replicate, smooth.

Test. Brit. tab. 15, fig. 8.

On the English and Scottish coasts, rare.

Coniferus, 19. *Coniferus.* Shell strong, taper, white, with six volutions, furnished with about twelve undulated ribs, the interstices between them at the top of each volution are formed into small cavities, transversely striated: aperture oval, oblique, strongly marginated; length a quarter of an inch.

Test. Brit. tab. 15, fig. 2.

First observed by Mr Bryer at Weymouth.

Denticulatus, 20. *Denticulatus.* Shell of six volutions, with nine or ten coarse ribs that project at the top of each spire; mouth suborbicular, outer lip thickened by a rib, pillar lip with two small tubercles adjoining the ribs.

Test. Brit. p. 315.

Found with the preceding species, to which it bears a close resemblance.

Decussatus, 21. *Decussatus.* Shell glossy white, with five rounded whorls, well defined by the separating line, strongly striated longitudinally, and crossed with extremely fine striæ; mouth sub-oval, contracted at the upper part; outer lip thin, inner lip not spreading on the columella; length one-eighth of an inch.

Test. Brit. tab. 12, fig. 4.

Found by Mr Montagu in sand from Salcomb bay.

Reticulatus, 22. *Reticulatus.* Shell strong, conic, opake, with six rounded and much raised whorls, strongly reticulated; apex pointed; mouth sub-orbicular, margin thick, inner lip spreading on the columella, and forming a groove or sub-umbilicus; length about one-tenth of an inch.

Test. Min. Rar. tab. 2. fig. 32.

Univalves.

From Seasalter by Mr Walker.

Spiralis, 23. *Spiralis.* Shell pellucid, white, conical, with five volutions; the largest marked with transverse spiral ridges, half way from the base, the rest finely ribbed longitudinally; separating line marked with a fine spiral ridge; pillar lip turns inwards, and forms a subdenticle; length a line.

Test. Brit. tab. 12, fig. 9.

Found by Mr Montagu in Salcomb bay.

Semicostatus, 24. *Semicostatus.* Shell short, conic, white, obtusely pointed, with five rounded whorls, well defined by the separating line, and wrought with faint ribs, and five obsolete transverse striæ on the body whorl; the ribs do not extend to the lower part even of the body whorl; pillar lip a little reflected; length half a line.

Test. Brit. tab. 21, fig. 5.

Found on the coast of Devon by Mr Montagu, and at Dunbar by Mr Laskey.

Strigatus, 25. *Strigatus.* Shell with three transverse ribbed whorls, and a suboval mouth; the colour opake, white.

Test. Min. Rar. tab. 2, fig. 38.

From Seasalter by Mr Walker.

Carinatulus, 26. *Carinatulus.* Shell opake, white, with seven taper longitudinally ribbed spires; mouth contracted, marginated.

Test. Min. Rar. tab. 2, fig. 44.

Found at Sandwich by Mr Walker, rare.

Albulus, 27. *Albulus.* Shell opake, with five longitudinal ribbed whorls; aperture roundish, not marginated.

Lin. Trans. vol. iii. tab. 13, fig. 17, 18.

Found on the coast of Pembrokeshire by Mr Adam.

Subelegans, 28. *Subelegans.* Shell with six whorls, striated spirally; the ribs remote; aperture oval.

Lin. *Trans.* vol. iii. tab. 13. fig. 31, 32.

Found with the preceding species.

Subarcuatus, 29. *Subarcuatus.* Shell pellucid, white, with ten longitudinal ribbed whorls, a little curved towards the point.

Lin. *Trans.* vol. iii. tab. 13. fig. 27. 28.

Found with the preceding species.

Marginatus, 30. *Marginatus.* Shell white, subcylindric, strong with six ribbed whorls, finely striated in a spiral direction; pillar lip thickened, outer lip extremely thick and rounded by a rib at the back; length three eighths of an inch.

Mem. Wernerian Soc. vol. i. tab. 8. fig. 13.

Found by Mr Laskey at Dunbar.

Indistinctus, 31. *Indistinctus.* Shell subcylindric, glossy white with six spires, nearly flat, but well defined by the separating line, striated longitudinally and transversely; pillar lip smooth, and a little spread upon the columella; length one-tenth of an inch.

Test. Brit. p. 129.

Described by Mr Montagu from the Boysian cabinet.

Simillimus, 32. *Simillimus.* Shell slender, white, with eight or nine spires furnished with 14 ribs standing in the line of the shell, bare and destitute of striæ; length three-eighths of an inch.

Test. Brit. p. 136.

Found by Mr Laskey on the shores of Jura.

D. Shells furnished with a pillar cavity, or umbilicus.

Elegans, 33. *Elegans.* Shell with five ventricose whorls, marked with strong spiral stria crossed by finer longitudinal ones; mouth orbicular, projecting on the pillar lip; margin faintly marked by the striæ; behind the pillar lip a sub-umbilicus; operculum spirally striated; length five-eighths of an inch; breadth three-eighths.

Brit. Zool. tab. 82. fig. 110.

Found plentifully in England under moss and at the roots of ferns.

Vinctus, 34. *Vinctus.* Shell smooth, conic, with six rounded volutions, of a rufous horn-colour; the lower spire marked with four or five chesnut coloured bands, with a broad space between the three lower and the upper; outer lip very thin, inner lip thick; pillar cavity small; length three-eighths of an inch.

Test. Brit. tab. 20. fig. 3.

Found by Mr Montagu in Salcomb bay.

Auricularis, 35. *Auricularis.* Shell horn-coloured with five rounded volutions deeply divided by the separating line; mouth sub-oval, outer lip thin, inner lip much reflected upon the body; length three-eighths of an inch.

Test. Brit. p. 308.

Found by Mr Montagu on the shore near Southampton. We have likewise observed it at Leith shore.

Canalis, 36. *Canalis.* Shell horn coloured with fine smooth volutions, the lower one large in proportion to the rest, pointed; mouth sub-orbicular, outer lip extremely thin, pillar lip broad, white, with a groove terminating in a pillar cavity or umbilicus; minutely sub-reticulated.

Test. Brit. tab. 12. fig. 11.

On the British shores frequent.

Subumbilicatus, 37. *Subumbilicatus.* Shell smooth, glossy, conic, yellowish white, with five tumid volutions, the first occupying above half the shell, rather obtuse, mouth oval, outer lip even, inner lip a little reflexed, forming a sulcus or sub-umbilicus; length one-eighth of an inch.

Pulteney's *Dorset.* tab. 18. fig. 12.

Found by Mr Bryer on the shore of Weymouth; we have likewise observed it in great plenty at St Andrew's.

Pallidus, 38. *Pallidus.* Shell smooth, white, slender with seven spires, volutions not much raised, but well defined by the separating line; outer lip arcuated; a faint duplicature on the pillar lip, with a small umbilicus formed by its reflexion; length one-eighth of an inch.

Test. Brit. tab. 21. fig. 4.

Found at Salcomb bay by Mr Montagu.

Quadrifasciatus, 39. *Quadrifasciatus.* Shell strong, smooth with four volutions, the first whorl sub-carinated at the lower edge, occupying more than half of the shell; colour white, usually marked with four faint brown bands on the body, and sometimes two on the second spire, minutely sub-reticulated; mouth sub-orbicular, thickened within, but sloped to a sharp edge on the outer lip, pillar lip grooved umbilicated; length about a quarter of an inch.

Test. Brit. tab. 20. fig. 7.

Found on the British shores, from Devonshire to Zetland.

Disjunctus, 40. *Disjunctus.* Shell slender, white, perfectly smooth with six rounded volutions, divided by a broad and deep line of separation, the bottom of which is flat or a little concave; pillar lip reflected, beneath which is a small umbilicus; length scarcely a quarter of an inch.

Mem. Wernerian Soc. vol. i. tab. 8. fig. 3.

Found by Mr Laskey on Belton sands near Dunbar.

Calcar, 41. *Calcar.* Shell somewhat compressed, with four whorls, the superior ones depressed, forming a flat summit; round the larger and part of the second whorls, are large smooth lanceolate spines, radiating in straight lines from the shell, and thirteen in number, base con-

Univalves. vex, umbilicated; colour pale pink, diameter upwards of a quarter of an inch.

Test. Brit. tab. 29. fig. 3.

Found by Mr Laskey on the shore of Iona.

E. Shells imperforated at the base of the columella.

Crassior, 42. *Crassior.* Shell yellowish white, thick, opake, conical, with five rounded whorls, divided by a deep depression, and terminating in a fine point; pillar lip wrinkled; length half an inch.

Test. Brit. tab. 20. fig. 1.
Brit. Shells, tab. 178. fig. 4.

Live shells are covered with a thin light yellowish brown epidermis, which sometimes rises into longitudinal ridges, beneath which a few obsolete spiral striæ are observed on the body whorl; common on the British shores.

Cimex, 43. *Cimex.* Shell with four strong, conical, reticulated, white volutions; apex obtuse; margin of the mouth thick, outer lip crenated on the inside; length one-eighth of an inch.

Brit. Shells, tab. 2. fig. 1.

On the English shores rare, and Mr Laskey has only once met with it near Dunbar.

Calathiscus, 44. *Calathiscus.* Shell conic, with six brown spires, elegantly tuberculated in spiral lines; on the body whorl are eight series of tubercles, on the second four rows, and afterwards one less in each succeeding superior volution till wholly lost at the apex; outer lip denticulated within; length a quarter of an inch.

Test. Brit. tab. 30. fig. 5.

Found by Mr Laskey on the island of Jura.

Ventrosus, 45. *Ventrosus.* Shell smooth, glossy, thin, with six ventricose whorls of a light pellucid horn colour, aperture suborbicular, closed by a thin wrinkled corneus operculum, margin almost entire the whole way round; length one-eighth of an inch.

Test. Brit. tab. 10. fig. 13.

On the coast of Kent frequent.

Ulvæ, 46. *Ulvæ.* Shell with seven smooth volutions, nearly flat, separated by a small line, apex moderately pointed; inner lip reflected on the columella, forming a slight depression behind, but no umbilicus; about three-eighths in length.

Brit. Zool. tab. 86. fig. 120.

On the British shores frequent.

Pullus 47. *Pullus.* Shell with four rounded glossy volutions, the first large, colour various; mouth sub-orbicular, large; length three-eighths of an inch.

Brit. Shells. tab. 2. fig. 2.

On the English shores not uncommon.

Punctura, 48. *Punctura.* Shell with six very glossy rounded volutions, rather taper in shape, and finely reticulated; colour transparent yellowish white; mouth suborbicular; length one-tenth of an inch.

Test. Brit. tab. 12. fig. 5.

On the British shores not uncommon.

Ruber, 49. *Ruber.* Shell with fine, smooth, pellucid, glossy, reddish brown volutions, rounded, and divided by a fine separating; aperture sub-orbicular, a little reflected on the pillar; length one-eighth of an inch.

Lin. Trans. vol. iii. tab. 13. fig. 21, 22.

Found by Mr Adam at Pembroke, and by Mr Montagu in Cornwall; we have observed it in Zetland.

Vitreus, 50. *Vitreus.* Shell with four very rounded, white, smooth, subcylindric volutions; mouth sub-oval, contracted at the upper end; outer lip thin, inner lip a little thickened; length one-eighth of an inch.

Test. Brit. tab. 12. fig. 3.

Found by Mr Montagu at Whitsand bay in Cornwall. Univalves.

51. *Nivosus.* Shell smooth, glossy, white, rather slender, and tapering to an obtuse point, volutions six, much rounded; length nearly a line. Nivosus,

Test. Brit. p. 326.

Found on the coast of Devon by Mr Montagu.

52. *Unifasciatus.* Shell smooth, conic, white, with one, and sometimes two bands of purplish brown on the body, one on the second spire, and sometimes also on the third; whorls five, a little raised; outer lip thin and turning outwards, inner lip spreading on the columella; length one-eighth of an inch. Unifasciatus,

Test. Brit. tab. 20. fig. 6.

On the English coast rare; found also at Dunbar by Mr Laskey.

53. *Cingillus.* Shell conical, pellucid, with six whorls, marked with alternate bands of horn-colour and chesnut brown, three of each on the body, and two on the other spires, which are obscurely striated; apex brown, aperture sub-oval, contracted at the upper part; length one-eighth of an inch. Cingillus,

Test. Brit. tab. 12. fig. 7.

On the English coast common.

54. *Interruptus.* Shell pellucid, glossy white, marked with interrupted longitudinal ochreaceous streaks, most conspicuous on the two larger spires; whorls five, not much raised; mouth sub-orbicular, inner lip reflected; length one-eighth of an inch. Interruptus,

Test. Brit. tab. 20. fig. 8.
British Shells, tab. 178. fig. 2.

Common to the British shores, from Devonshire to Zetland.

55. *Retiformis.* Shell white, opake, with four tumid reticulated spires, with an oval aperture. Retiformis,

Test. Min. Rar. tab. 2. fig. 37.

From Sandwich, Mr Walker.

56. *Fuscus.* Shell brown, opake, spires fine, striated, aperture suboval. Fuscus.

Test. Min. Rar. tab. 2. fig. 42.

From Bysing wood near Faversham, rare, Mr Walker.

57. *Rivulus.* Shell white, opake, striated; whorls four; mouth oval, marginated. Rivulus,

Test. Min. Rar. tab. 2. fig.

From a stream near Faversham. Mr Walker.

58. *Fulgidus.* Shell subconic, pellucid, smooth, variegated with white and bronze, usually in bands; whorls three, the first very large, mouth suborbicular, margin attenuated; length half a line. Fulgidus,

Test. Brit. p. 332.

Found by Mr Montagu in sand from Whitsand-bay, Cornwall.

59. *Scriptus.* Shell smooth, with three whorls, marked with brown lines resembling characters; aperture roundish. Scriptus,

Lin. Trans. vol. 3. tab. 13. fig. 11, 12.

Found by Mr Adams on the coast of Pembroke.

60. *Divisus.* Shell pellucid, white, with four whorls each divided into two parts, the upper one smooth, the lower one spirally striate; aperture suboval. Divisus,

Found along with the last.

61. *Subrufus.* Shell smooth, with fine whorls, somewhat angular above; opake; dull red; the upper part of each whorl marked with a white transverse band. Subrufus,

Lin. Trans. vol. v. tab. 1. fig. 18, 19.

Found with the two preceding species.

64. *Ziczac.* Shell conic, with six substriated, white or purplish white spires, marked with equidistant, longitudinal, undulated, purple lines; apex acute; base Ziczac.

Univalves.

sub-carinated; mouth subovate; length half an inch; breadth a quarter.

Lin. Trans. vol. viii. tab. 4. fig. 14.

Found by Lady Wilson near Sunderland, in the county of Durham.

Semistriatus.

63. *Semistriatus.* Shell thick, conic, white, with six rounded spires; base of the shell, as far as the upper angle of the mouth, finely striated spirally; the same is observable on the upper and lower parts of the other volutions; mouth angulated at the interior end; pillar lip thickened on the columella; length one eighth of an inch.

Test. Brit. Sup. p. 136.

Found by Mr Montagu on the coast of South Devon.

Genus XIV. Odostomia.

XIV. Odostomia.

Shell spiral, produced, mouth contracted, subangular, generally distinct from the body whorl, and furnished with teeth.

Obs. The shells which we have formed into the present genus were included by Linnæus in the turreted division of his genus *turbo.* They were thus associated with species to which they bear no affinity in habit, and from which they differ in character. By far the greater number inhabit the land, and are found under stones, on rocks, and among moss. The genus admits of a twofold sub-division.

A. Spires dextral.

Muscorum,

1. *Muscorum.* Shell smooth, glossy, horn-coloured, sub-cylindric, with six spires; apex obtuse; mouth suborbicular marginated; the margin white, a little reflected; pillar lip, furnished with a single tooth; length about the eighth of an inch.

Test. Brit. tab. 22. fig. 3. T. muscorum.

A very common species at the roots of trees and under stones.

Sexdentata,

2. *Sexdentata.* Shell smooth, brown, horn-coloured, with five spires, somewhat rounded; aperture sub-orbicular; outer lip uneven, sub-angulated, usually furnished with six teeth, four on the outer lip and two on the inner; length a line.

Test. Brit. tab. 12. fig. 8.

In marshes in England on the Iris pseudacorus.

Tridens,

3. *Tridens.* Shell sub-cylindrical, smooth, glossy, of a light brown colour; volutions seven; scarcely raised; apex obtuse; mouth small and curved; outer lip furnished with one tooth on the margin; pillar lip a little reflected, with two long and two short teeth alternately; length a quarter of an inch.

Mem. Wernerian Soc. vol. i. tab. 8. fig. 11.

In England rare. Mr Laskey found it in Caroline park near Edinburgh,

Carychium,

4. *Carychium.* Shell glossy, pellucid, white, with five longitudinally striated whorls, rounded, and well defined by the separating line; mouth suboval, contracted, marginated; outer lip thickened inwards by a knob; pillar lip furnished with two teeth, and sometimes the rudiments of a third above the other two; length about a line.

Test. Brit. tab. 22. fig. 2.

Common in woods and mossy banks in England and Scotland.

Juniperi,

5. *Juniperi.* Shell sub-cylindric, opake, brown, with nine spires striated longitudinally oblique; the four first volutions are cylindrical, the rest taper to an obtuse apex; mouth sub-orbicular, marginated, reflected, white, with three teeth on the outer lip, and four on the columella; a cavity behind the pillar lip; length upwards of a quarter of an inch.

Test. Brit. tab. 12. fig. 12.

Found by Mr Montague and Mr Bryer in England. Mr Laskey has found it at Dunbar. It inhabits the roots of juniper bushes.

Interstincta,

6. *Interstincta.* Shell glossy, white, taper, with five rather flat, but finely ribbed volutions; mouth suboval; pillar lip a little reflected, with a single small tooth; length about a line.

Test. Brit. tab. 12. fig. 10.

A rare shell; found by Mr Montagu in sand from Bigberry-bay in Devonshire.

Unidentata,

7. *Unidentata.* Shell strong, conic, smooth, glossy, subpellucid, volutions six, not much raised; aperture sub-oval; outer lip plain; columella furnished near the middle with one tooth; length two-tenths of an inch.

Test. Brit. p. 324.

Found in Salcomb bay adhering to the *Pecten maximus.*

Plicata,

8. *Plicata.* Shell smooth, glossy, subpellucid, white, with six rather slender spires, terminating in an obtuse apex; volutions nearly flat; aperture contracted a little to an angle on the upper part; outer lip even; inner lip furnished with a single toothlike fold.

Test. Brit. tab. 21. fig. 2.

Found in sand from Salcomb bay by Mr Montagu.

Sandvicensis,

9. *Sandvicensis.* Shell pellucid, white, spires three, elegantly reticulated; aperture oval; one tooth.

Test. Min. Rar. tab. 2. fig. 55.

From Sandwich. Mr Walker.

Insculpta,

10. *Insculpta.* Shell pellucid, white and taper, with five or six moderately convex whorls, striated spirally; apex obtusely pointed; aperture subovate; pillar lip, with a faint duplicature forming a sub-umbilicus, and furnished with a small tooth; length one-eighth of an inch.

Test. Brit. Sup. p. 129.

A rare shell, found on the coast of Devon by Mr Montagu.

B. Spires Sinistral.

Perversa,

11. *Perversa.* Shell with eight or nine regular tapering spires, obsoletely striated; volutions a little rounded and divided by a deep separating line; mouth suborbicular; outer lip a little reflected; pillar lip not detached, edges white, thin, at the upper angle a toothlike knob; length nearly a quarter of an inch.

Test. Brit. tab. 11. fig. 12.

Animal dusky above, light beneath; tentacula four, short, cylindric, clavate, furnished with eyes at the tips of the longest. Found on rocks, trees, and moss, in England and Scotland common.

Nigricans,

12. *Nigricans.* Shell taper, swelling a little in the middle, and marked with fine longitudinal striæ; volutions rather flat, but well defined and twelve in number; mouth compressed on the outer angle near to the body; pillar lip furnished with two teeth, and perfectly detached from the body whorl; at the back of the lower volution, behind the mouth, is a prominent ridge and a depression.

Test. Brit. tab. 11. fig. 7.—Turbo-bidens.

Animal dusky; tentacula four, short, cylindric, clavate; the two longest furnished with eyes at their tips. A very common shell on rocks, trees, and moss in both kingdoms.

Laminata,

13. *Laminata.* Shell smooth, glossy, pellucid, with ten spires; thickest in the middle, tapering from thence to a small round point; volutions a little raised; mouth

Univalves. compressed at the upper outer margin, where it joins the body; lip white; pillar lip furnished with two teeth, and deep within the mouth are three or four prominent ridges; length nearly three quarters of an inch.

Test. Brit. tab. 11. fig. 4.

Animal light brown, paler beneath, tentacula and eyes resembling the preceding species.

Biplicata, 14. *Biplicata.* Shell with twelve or thirteen taper striated spires; mouth compressed at the upper part, and slightly at the extremity; lips thick, white, reflected; margin connected all round; pillar lip prominent and detached, furnished with two white approximating teeth-like laminæ; length three quarters of an inch.

Labiata, 15. *Labiata.* Shell light brown, opake, taper, with nine spires, wrought with strong and regular striæ the whole length of the shell; volutions flat; mouth suborbicular with a sinus at the upper end, and furnished with two teeth-like laminæ on the inner lip; margin very broad, thick, and white; pillar lip a little detached from the body whorl; length five eighths of an inch.

Test. Brit. tab. 11. fig. 6.

Found by Mr Swainson in ozier grounds at Battersea, Surry.

Vertigo. 16. *Vertigo.* Shell oval, opake, brown, with five faintly striated spires; apex obtuse; aperture sub-triangular, sub-marginated, indented, usually furnished with three white teeth, two on the columella, and one on the exterior lip opposite; length half a line.

Test. Brit. tab. 12. fig. 6.

Tentacula two, with eyes at their tips. Found by Mr Boys and Mr Montagu on old ivy walls.

Genus XV. Lymnæa.

XV. Lymnæa. *Shell ovate conical, mouth entire, longitudinally oblong, the right lip joined to the left at the base and folding back on the pillar.*

Obs. The genus Helix of Linnæus is unquestionably a confused one. The discoide species of that genus we have already considered under the genus Planorbis, and the turreted species from the present genus, which was constituted by Lamarck, and of which Latreille gives the following definition: " *Coquille oblongue, presque turriculée; l'ouverture entière, plus longue que large; partie inférieure du bord droit remontant en rentrant dans l'ouverture, et formant sur la columelle un pli très oblique.*"

Stagnalis, 1. *Stagnalis.* Shell thin, translucent, with six or seven spires; the first very large, the others small and tapering to a fine point; slightly wrinkled longitudinally; outer lip thin, pillar lip thickened. Length one inch and three quarters; breadth one inch.

Brit. Zool. tab. 86. fig. 136. Helix.
Test. Brit. tab. 16. fig. 8.

This species is the largest of the British fresh water univalves. It inhabits slow running rivers and stagnant waters.

Fragilis, 2. *Fragilis.* Shell thin, translucent, horn-coloured; slender in the superior volutions; whorls little raised.

Test. Brit. tab. 16. fig. 7.

Found by Mr Montagu in the canal between Chippenham and Laycock in Wiltshire.

Palustris, 3. *Palustris.* Shell horn-coloured, with six spires tapering to a sharp point; whorls slightly wrinkled longitudinally, sometimes marked with irregular transverse ridges; length an inch, breadth three eighths.

Test. Brit. tab. 16. fig. 10.
Brit. Shells. tab. 175. fig. 1, 2.

In ditches and swamps in England. It has been observed in Duddingstone Loch, near Edinburgh, by Dr Leach. Univalves.

4. *Fossaria.* Shell thin, horn-coloured, tapering, with five or six spires; whorls rounded, divided by a well-defined separating line; length three eighths of an inch; breadth about one third of its length. Fossaria,

Test. Brit. tab. 16. fig. 9.

Animal dusky; tentacula two, somewhat compressed, short; eyes on the head at the base of the tentacula. In shallow pools exposed to the sun and in muddy ditches. Common in England and Scotland.

5. *Putris.* Shell with four spires, the first very large, the others small, apex fine pointed; mouth large oval, three fourths of the length of the shell; usually covered with a dusky brown epidermis; length one inch, breadth five-eighths. Putris,

Brit. Zool. tab. 86. fig. 137.
Test. Brit. tab. 16. fig. 3. Helix peregra.

The animal is an aquatic species of a yellowish colour, with two broad flat pyramidal tentacula, eyes at the base of the tentacula beneath. Common in Britain in almost every ditch.

6. *Auricularia.* Shell thin, sub-pellucid, with four spires, the first extremely large occupying almost the whole of the shell; apex pointed; body whorl longitudinally wrinkled; outer lip much extended, thin, and sub-reflected; length about an inch, breadth three quarters of an inch. Auricularia,

Brit. Zool. tab. 86. fig. 138. Helix auricularis.
Brit. Shells. tab. 51. fig. 1.
Test. Brit. tab. 16. fig. 2.

Tentacula of the animal broad, flat, conic, speckled with brighter yellow. Found in stagnant pools in England; common in Scotland. Somewhat rare.

The variety of this shell termed *Helix limosa, Test. Brit.* tab. 16, fig. 1, is only the young of this species. The first volution is less ventricose, and thinner, and the mouth not so patulous; but it has no character to entitle it to be considered as distinct. The *Helix limosa* of Linnæus is essentially different.

7. *Succinea.* Shell very thin, pellucid, glossy, reddish-yellow, with three spires, the first very large, wrinkled longitudinally; mouth oval, occupying two-thirds of the shell; outer lip submembranaceous; pillar lip slightly thickened; length three-quarters of an inch. Succinea,

Test. Brit. tab. 16, fig. 4, *Helix putris.*

The animal of this shell has four tentacula. This species resides upon the leaves and stalks of subaquatic plants. It is a very common species in Britain.

8. *Lutea.* Shell sub-oval, sub-pellucid, with about three whorls, the first very large; mouth oval, expanded; length nearly half an inch; breadth rather more than a quarter. Lutea,

Test. Brit. tab. 16, fig. 6.

It is exceedingly doubtful, whether this is a land or a sea shell. Mr Montagu has found it on the open part of the coast of South Devon.

9. *Detrita.* Shell conic, sub-pellucid, with six whorls, not much elevated, but a little rounded, and separated by a well defined line; colour white, glossy; a little wrinkled longitudinally, and commonly marked with one ferruginous band round the middle of the body; mouth oval; length three quarters of an inch; breadth three-eighths. Detrita,

Test. Brit. tab. 11, fig. 1.

Found by Mr Bryer in a pool near Weymouth, and in a stream near Dorchester.

10. *Vivipara.* Shell with six ventricose spires, separated by a deep depressed line; shape sub-conic, sud- Vivipara,

Univalves.

denly terminating in a small point; colour olive green, with three brownish bands on the body; aperture suborbicular; operculum corneus, pellucid, and wrinkled concentrically; length rarely an inch and a half.

Brit. Zool. tab. 84, fig. 132.

Brit. Shells, tab. 87.

The animal is dusky black, thickly speckled with orange-yellow; the snout is produced. This species is viviparous. Found in the Thames, and streams communicating with that river; also in the Stour, Dorsetshire.

Fontinalis,

11. *Fontinalis.* Shell thin, sub-pellucid; horn-coloured, with four or five much rounded, prominent, smooth whorls; apex obtuse; aperture perfectly orbicular; lips thin; inner lip slightly attached to the body whorl; pillar cavity deep; operculum corneus with a small knob in the centre; length and breadth nearly the same, rarely exceeding a quarter of an inch.

Brit. Shells, tab. 102.

The animal has two tentacula placed as usual, another on the right side, and on the middle of the hind head a pellucid plumose appendage. Common in England and Scotland in deep pools and stagnant waters. This species has changed its place in the system of conchology repeatedly, having, in succession, been placed in the genera *Helix, Nerita, Trochus,* and *Turbo;* thus intimating its remote connection with all of them.

Tentaculata,

12. *Tentaculata.* Shell smooth, conic; horn-coloured, with six rounded spires, divided by a deep separating line; apex pointed; mouth sub-orbicular, contracted at the upper part; outer lip moderately strong; operculum testaceous, concentrically wrinkled; length half an inch; breadth a quarter.

Brit. Zool. tab. 86, fig. 140, *Helix tentaculata,* &c.

Brit. Shells, tab. 93.

Animal pale, with two very long slender setaceous tentacula, which are continually in motion; at the base of these are situated the eyes. It is a common species in England, in most slow rivers and stagnant waters.

Elegantissima,

13. *Elegantissima.* Shell with thirteen flat spires, long, taper; volutions cut into regular equidistant furrows; aperture a little angulated at the upper and lower parts; length about a quarter of an inch.

Test. Brit. tab. 10, fig. 2.

On the English coast not uncommon; also found at Dunbar by Mr Laskey.

Lubrica,

14. *Lubrica.* Shell smooth, glossy, pellucid, horn coloured, with six spires very little rounded, and not much raised; apex rather obtuse; mouth oval; outer lip rather thick; length a quarter of an inch; breadth one-third of its length.

Test. Brit. tab. 22, fig. 6.

Lin. Trans. vol. viii. tab. 5, fig. 11.

This shell is very easily distinguished when alive by its extreme glossiness. It resides in moist woods, among moss, or under decayed wood. It is a very common British shell.

Obscura,

15. *Obscura.* Shell sub-cylindric, opake, brown, with about seven spires, a little rounded, and well defined by the separating line; whorls wrinkled longitudinally; mouth oval, marginated white; length three-eighths of an inch; breadth more than one-third of its length.

Test. Brit. tab. 22, fig. 5.

Lin. Trans. vol. viii. tab. 5, fig. 11.

This animal inhabits the same places with the preceding. We have likewise observed it, particularly on Arthur's Seat near Edinburgh, on the sides of stones, and in the winter under them. A British shell not uncommon.

1

Univalves.

Subcylindrica,

16. *Subcylindrica.* Shell cylindric, imperforated, subpellucid, light chesnut coloured, with four spires, terminating in an obtuse, smooth, button-like whorl, as if truncated; the volutions a little rounded, and well defined by the separating line; furnished with close set rib-like longitudinal striæ; mouth oval; length a quarter of an inch.

Pult. H. Dorset. tab. 19, fig. 8.

According to Dr Pulteney, this shell is found on water plants in rivers and ponds in Dorsetshire. Suspicions are generally entertained, that the Doctor, in respect to this shell, was deceived. We have found his shell in the Frith of Forth, but still not in a situation to enable us to determine with absolute certainty, whether it is a sea or land species. It was found, along with fragments of sea-shells, in the cavity of a dead *Echinus lacunosus.*

Fasciata,

17. *Fasciata.* Shell thin, taper, with nine spires, a little rounded, but not much raised; apex moderately pointed; whorls wrinkled across; colour white, longitudinally striated with brown; length nearly three quarters of an inch; breadth a quarter.

Brit. Zool. tab. 82, fig. 119.

Brit. Shells, tab. 18.

Found in great profusion in some places near the south coast of England, on sandy soil. It has likewise been found in Scotland by Mr Hansen at Iona.

Lackhamensis,

18. *Lackhamensis.* Shell sub-pellucid, of a dull rusty brown colour; wrinkled longitudinally; volutions seven, nearly flat, but well defined by the separating line; the three or four first whorls sub-cylindrical, the rest more suddenly taper to an obtuse point; mouth marginated; length five-eighths of an inch; breadth a quarter.

Test. Brit. tab. 11, fig. 3.

Found by Mr Montagu in a moist wood at Lackham in Wiltshire.

Octona,

19. *Octona.* Shell with eight whorls; mouth nearly orbicular; about the size of a grain of rye, and of a horn-colour.

Pult. H. Dorset. tab. 18, fig. 8.

Lin. Trans. vol. viii. fig. 10.

This species is inserted solely on Dr Pulteney's authority. " He says, " I have only found it dead, and in a bleached state, but otherwise perfect."

Octanfracta,

20. *Octanfracta.* Shell pellucid, horn-coloured, with seven or eight smooth or very finely wrinkled slender spires, gradually tapering to a fine point; the volutions are rather flat, but well defined by the separating line; mouth oval; outer-lip very thin; length about five-eighths, breadth two-tenths of an inch.

Test. Brit. tab. 11. fig. 8. *Helix octanfracta.*

This shell is probably the Helix octana of Pennant. It is rather a rare English shell; and, in Scotland, we have only observed it in ditches, in the upland parts of Linlithgowshire. It occasionally, as we have noticed, climbs up the stalks and leaves of aquatic plants, and, in being thus amphibious, resembles the *L. fossaria.*

Polita,

21. *Polita.* Shell strong white, glossy, smooth; volutions from nine to thirteen, flat and scarcely separated; slender and gradually tapering to a fine point; aperture oval, and forming a contraction at the upper end; outer lip rather thick; length five-eighths of an inch, breadth two-tenths.

Brit. Shells, tab. 177.

Found sparingly on the western coasts of England. Mr Laskey has found it at Dunbar.

Decussata,

22. *Decussata.* Shell slender, white, with eight or nine spires tapering to a fine point; whorls striated

Univalves. strongly in a longitudinal direction; mouth narrow, sub-oval, contracted at both ends; outer lip somewhat expanded, and a little thickened at the back; length three-tenths of an inch, breadth one-tenth.

Test. Brit. tab. 15. fig. 7.

Found by Mr Bryer on the shore between Weymouth and Portland Island.

Labiosa, 22. *Labiosa.* Shell sub-conic, sub-pellucid, with seven or eight flattish spires ending in a fine point, and furnished with from fifteen to eighteen faint ribs on the three largest whorls; the superior volutions smooth; lips thickened, within white; the back of the outer lip a little gibbose; length rather more than a quarter of an inch, breadth nearly one half of its length.

Test. Brit. tab. 13. fig. 7.

A shell not uncommon in England. Has been found in Scotland, on the coast at Dunbar, by Mr Laskey.

Subulata, 23. *Subulata.* Shell subulate, smooth, glossy, with about ten scarcely defined whorls; colour white, marked with two faint yellowish lines, which follow the spiral turn of the shell, but become obsolete towards the apex; mouth narrow, contracted at the interior angle; length about three-quarters of an inch.

Brit. Shells, tab. 172.

First noticed by Da Costa, from Exmouth in Devonshire; Mr Donovan received it from Weymouth; and Mr Laskey found it at Dunbar.

Petræa. 24. *Petræa.* Shell strong, conic, opake, with five spires, occupying nearly two-thirds of the length of the shell, and irregularly wrinkled; mouth lunated; outer lip considerably projecting, operculum corneus; length about a quarter of an inch, breadth two-tenths of an inch.

Test. Brit. p. 403.

Found on the coast of Devon and Dorset by Mr Montagu.

Family II. GLOBOSE.

The shells which this family includes are, in form, somewhat orbicular. The first, or body whorl, is large; the remaining volutions decrease in size to the apex rather suddenly. The apex is seldom much produced. In consequence of this shape of the whorls, the shell is broader than it is long. The mouth is entire, and of a roundish form. The common garden slug (*Helix aspersa*) may be considered as the type of the family. At present we shall consider the British species under the three following genera: Helix, Nerita, and Trochus.

Genus XVI. Helix.

XVI. Helix. *Shell subglobose, with a convex spire; the opening entire, wider than long, and diminished in its upper part by the projection of the last turn but one of the spire.*

Obs. The shells of this genus, with a few exceptions, are inhabitants of the land. They are usually translucent and brittle. The species of the genus admit of distribution into two subdivisions. The first will contain those shells which are furnished with a pillar cavity, or in which the base of the pillar is perforated. The second will include those in which the base of the pillar is closed. The land shells of this subdivision have the base of the pillar perforated in the earlier stages of their growth, and until the margin of the mouth is formed.

A. Base perforated.

Pomatia, 1. *Pomatia.* Shell sub-globose, translucent, yellowish brown with five rounded whorls wrinkled longitudinally; mouth semilunated; margin a little thickened; inner lip much reflected over the pillar cavity; diameter about two inches.

Brit. Zool. tab. 84. fig. 128.

The name of this species is derived, not from any thing relating to an orchard, but from Πωμα, an operculum, it having a very strong one. It is not indigenous, or originally a native of Britain, but is a naturalized species. It was first introduced into England by a Mr Howard about the middle of the 16th century. In the southern counties it is very common. We have likewise observed them in the garden of Patrick Neill, Esq. at Canonmills, near Edinburgh, into which they were lately introduced. They were a favourite dish among the Romans.

Virgata, 2. *Virgata.* Shell with six rounded volutions considerably produced. Colour white tinged with black, with one dark purplish brown band on the middle of the body; mouth lunated, lip thin, pale purplish brown, with a white thread-like elevation round the margin; pillar cavity deep; length generally half an inch.

Test. Brit. tab. 24. fig. 1.

Brit Shells. tab. 65. *H. Zonaria.*

Inhabits dry banks and sandy soils in various parts of England.

Cingenda, 3. *Cingenda.* Shell sub-pellucid, with five whorls; the larger ones are a little angulated at the top, apex dark, obtuse and depressed; colour yellowish white, with several small bands of chesnut running spirally up the shell; the base has generally one circular band; minutely striated longitudinally and transversely; pillar cavity very small; breadth at the base three quarters of an inch; height half an inch.

Brit. Zool. tab. 85. fig. 133. *H. Zonaria.*

Lin. Trans. vol. viii. tab. 5. fig. 6.

Found by Mr Montagu at Lenby in South Wales, and Mr Racket has found it near St Ives in Cornwall. It lives upon maritime plants.

Rufescens, 4. *Rufescens.* Shell rufous with six whorls, well separated, a little rounded wrinkled across; edge of the lower volution sub-carinated; mouth lunated; outer lip thin, and a little reflected at the lower angle; pillar cavity large and deep; diameter at the base half an inch.

Brit. Shells. tab. 57. fig. 1. 1.

Test. Brit. tab. 23. fig. 2.

This shell, when young, is thickly covered with short hairs seated on the epidermis. It inhabits moist woods and under stones. It is very common in England and Scotland.

Cantiana, 5. *Cantiana.* Shell with six volutions, rounded, well defined by the separating line; mouth lunated; margin a little thickened, inner lip reflected; pillar cavity narrow but deep. Diameter at the base above three quarters of an inch; height half an inch.

Brit. Shells. tab. 157. fig. 2. 2. *H. pallida.*

This species somewhat resembles the preceding; it is however larger, of a lighter colour, and has a smaller pillar cavity. It is found in meadows and hedges in Kent, Surry, and Dorset.

Hispida, 6. *Hispida.* Shell sub-globose, thin, fragile, with five rounded volutions of a light horn-colour, covered with fine thick-set short whitish hairs; apex flattened; mouth lunated; inner lip a little reflected; pillar cavity small, round; diameter about a quarter of an inch.

Test. Brit. tab. 23. fig. 3.

Found among moss in England, not uncommon. We have found it frequently in Scotland The shape of

Univalves. the pillar cavity, and the reflection of the pillar lip, distinguish it from the *H. rufescens*, with the young of which it has frequently been confounded.

Lucida, 7. *Lucida.* Shell smooth, glossy, horn-coloured, with five or six volutions, the lower one rounded, the rest almost flat; mouth lunated, margin thin; pillar cavity large and deep. Diameter usually three eighths of an inch.

Test. Brit. tab. 23. fig. 4.

Lin. Trans. vol. viii. tab. 5. fig. 7. *H. nitius.*

A common British shell. It is likewise very common in Zetland. It frequents moss, old walls and stones.

Trochiformis, 8. *Trochiformis.* Shell thin, smooth, glossy, horn-coloured, with six rounded volutions, strongly divided by the separating line; apex considerably produced; base a little rounded; mouth sub-lunated, transversely compressed; lip attenuated; pillar cavity small; diameter about one eighth of an inch.

Test. Brit. tab. 11. fig. 9.

This is a rare shell. Found in Wiltshire and Devonshire by Mr Montagu.

Lacuna, 9. *Lacuna.* Shell thin, sub-globose, of a light horn-colour, with four tumid smooth spires, the first large, the two uppermost very small, and placed somewhat laterally; mouth large, outer lip thin, pillar lip thick, white, grooved, with a long canal which ends in a small but deep pillar cavity. Diameter about a quarter of an inch.

Test. Brit. tab. 13. fig. 6.

Found by Mr Montagu on the shore, about high-water mark, at Southampton, and sparingly on the Devonshire coast. Mr Laskey has likewise found it at Dunbar.

Spinulosa, 10. *Spinulosa.* Shell sub-pellucid, with five rounded volutions well defined by the separating line, furnished with regular membranaceous striæ that rise into fine hair-like spines, particularly round the middle of each volution; apex considerably produced; mouth semilunated; pillar cavity small; diameter about one-tenth of an inch.

Test. Brit. tab. 11. fig. 10.

This shell is rather a local species. It has been found in several places in England. We have found it in Scotland at Tarvet mill near Cupar, Fifeshire, among moss.

Caperata, 11. *Caperata.* Shell sub-pellucid, somewhat compressed, with six whorls, furnished with strong, regular, close-set, longitudinal striæ. On the upper part of the body whorl there is usually a brown belt; mouth lunated; lip thin, not reflected; pillar cavity large and deep; diameter at the base about half an inch.

Test. Brit. tab. 11. fig. 11.

In England among dry short pasture, frequent. Found likewise at Musselburgh by Mr Laskey.

Radiata, 12. *Radiata.* Shell compressed, sub-carinated, rayed with chesnut; whorls six, not much raised, but well defined by the separating line, and strongly marked with close set regular longitudinal striæ from the apex across the volutions; pillar cavity very large; diameter a quarter of an inch.

Pulteney's Dorset. tab. 20, fig. 15, 16.

Test. Brit. tab. 24, fig. 3.

A common British shell, found under stones, old timber, and among moss.

Umbilicata, 13. *Umbilicata.* Shell horn-coloured, with five whorls; much rounded, deeply divided by the separating line, and finely striated across the whorls; apex a little produced; lip attenuated; pillar cavity large and deep; diameter one tenth of an inch.

Test. Brit. tab. 13, fig. 2.

Found by Mr Montagu at several places in England; we have likewise observed it common in Scotland. It is found in the same places with the preceding, to which it bears a resemblance, and with which it may easily be confounded.

14. *Lapicida.* Shell sub-pellucid, compressed, brown variegated with darker shades; whorls five, almost flat, the lowest whorl carinated or brought to a sharp edge; striated transversely; pillar cavity wide and deep; mouth suboval; margin sharp, white, outer lip reflected, inner lip spreading on the body; diameter three quarters of an inch. Lapicida,

Brit. Zool. tab. 83, fig. 121.

Brit. Shells. tab. 39, fig. 2.

Inhabits England in shady woods, as well as rocky exposed situations.

15. *Ericetorum.* Shell sub-pellucid; whorls six; the first remarkably rounded, the superior ones scarcely elevated above the body whorl; wrinkled transversely; on the upper part of the large whorl is a brown band, which continues spirally at the bottom of each of the smaller volutions, and marks their division; pillar cavity large and deep; mouth suborbicular; margin thin; diameter three quarters of an inch. Ericetorum,

Brit. Shells. tab. 151, fig. 2.

Brit. Zool. tab. 85, fig. 122. *H. albella.*

Common in England upon dry sandy heaths; has likewise been found in Iona, by Mr Hanson.

16. *Subcarinata.* Shell white, sub-pellucid with three whorls, the lower one large, the others small, a little produced and placed somewhat laterally; round the base of the body wreath are two fine ridges; pillar cavity deep and large; mouth oval, outer lip projecting considerably; inner lip reflected; diameter one tenth of an inch. Subcarinata,

Test. Brit. tab. 7, fig. 9.

Found by Mr Montagu in sand from Salcomb bay, and other places on the south coast of Devon.

17. *Depressa.* Shell light brown subpellucid; volutions three or four, the superior ones scarcely elevated above the body, lower volution cylindrical; pillar cavity large; mouth round, nearly even, lateral and not clasping the body, but spreading a little on that part. Depressa,

Test. Brit. tab. 13, fig. 5.

Found by Mr Montagu in sand from Whitsand bay, and Falmouth in Cornwall, and at Burrow island Devonshire.

18. *Paludosa.* Shell smooth, white, with four rounded volutions, well defined, apex little elevated; pillar cavity large; mouth round; margin thick, opake, white, reflected; diameter one tenth of an inch. Paludosa,

Lin. Trans. vol. viii. tab. 5, fig. 5.

Test. Brit. tab. 13. fig. 3. *var. H. crenella.*

Found among moss, under decayed leaves, and in marshes, common in England and Scotland. A variety sometimes occurs with the volutions striated across in a strong and regular manner, with a light brown epidermis. This was figured by Lightfoot, *Phil. Trans.* 76. tab. 3, fig. 1, 2, 3, 4.

19. *Unispiralis.* Shell white, opake, glossy; mouth round, with one whorl, with a central cavity on both sides. Unispiralis,

Test. Min. Rar. tab. 1, fig. 27.

Found at Sandwich; not common.

20. *Resupinata.* Shell horn-coloured, semi-pellucid, Resupinata,

Univalves.

glossy; mouth oval, large; spires of the tip turned backwards.

Test. Min. Rar. tab. 1, fig. 24.

From Sandwich; very rare.

Reticulata,

21. *Reticulata.* Shell white, pellucid; with one reticulated whorl; mouth round; central cavity small.

Test. Min. Rar. tab. 1. fig. 26.

From Reculver; extremely rare.

Tubulata,

22. *Tubulata.* Shell with three longitudinally striate whorls; a margined tube at the base, instead of a pillar cavity, extending beyond the surface of the shell.

Lin. Trans. vol. iii. tab. 13, fig. 35, 36.

Found on the coast of Pembrokeshire, by Mr Adam.

Fasciata,

23. *Fasciata.* Shell pellucid, white, the first spire marked with three transverse purple belts, the middle one broad, the lateral ones narrow; whorls three, smooth, the first large; mouth expanded, with a small pillar cavity.

Lin. Trans. vol. v. tab. 1, fig. 20, 21.

Nitidissima,

24. *Nitidissima.* Shell corneus, pellucid, with two whorls very finely striated transversely, extremity glossy; pillar cavity distinct.

Lin. Trans. vol. v. tab. 1, fig. 22—24.

Found with the preceding species.

Bicolor,

25. *Bicolor.* Shell smooth dull, inside of the shell white, pillar cavity small.

Lin. Trans. vol. v. tab. 1, fig. 25—27.

The four preceding species were found by Mr Adam on the coast of Pembrokeshire.

Margarita,

26. *Margarita.* Shell with four strong convex volutions; colour white, pearlaceous, with one faint rufous brown band on the upper part of the body whorl; mouth sublunated; inside nacred; base very convex; pillar cavity large; diameter one eighth of an inch.

Mem. Wer. Soc. vol. i. tab. 8, fig. 5.

First observed on the Scottish coast at Dunbar by Mr Laskey; we have found it on other parts of the same coast, and in Orkney and Zetland where it is plentiful.

Serpuloides,

27. *Serpuloides.* Shell white, glossy, with three cylindrical volutions destitute of striæ, apex depressed scarcely elevated above the other whorls; mouth orbicular, slightly adhering to the body, and turning considerably downwards, forming a large and deep pillar cavity.

Test. Brit. tab. 21, fig. 3.

Found on the coast of Devon by Mr Montagu. A variety very minutely striated occurs in great abundance on the coast of Zetland.

B. Base Imperforated.

Aspersa,

28. *Aspersa.* Shell marked with *fasciæ* of dark brown, sub-globose, with four volutions, the superior ones placed somewhat laterally; mouth semilunar, elongated, margin reflected, white; diameter about an inch and half.

Brit. Zool. tab. 84, fig. 129. *H. hortensis.*

Brit. Shells, tab. 131.

This is a very common species, about old garden walls, hedges and groves.

Nemoralis,

29 *Nemoralis.* Shell sub-globose, with five volutions, most frequently yellowish or reddish, fasciated with dark coloured bands, those with five bands have the two uppermost much smaller than the rest; mouth lunated margined; inner edge of the lip and pillar invariably of a dark colour; diameter scarcely an inch.

Brit. Shells, tab. 13.

A common British shell, in woods, hedges, and shady places.

Hortensis,

30. *Hortensis.* Shell sub-globose with five volutions, resembling the last, but in this the margin of the mouth is black; greatest diameter three quarters of an inch.

Found in similar situations with the preceding, in England and Scotland.

Arbustorum,

31. *Arbustorum.* Shell sub-globose with five volutions, a little rounded, well defined by the separating line, and wrinkled longitudinally with a single band of brown about the middle of the whorl; mouth lunated; margin reflected; the inside bordered with white; diameter about three quarters of an inch.

Brit. Zool. tab. 85, fig. 130.

Brit. Shells, tab. 136.

Delights in black boggy soil among trees; a common species in Britain. It is found likewise in Orkney and Zetland.

Fusca,

32. *Fusca.* Shell thin, pellucid, with five or six smooth whorls; mouth lunated; lip thin, not reflected, except a little at the lower angle, at which part is a small depression, but no pillar cavity; diameter about three eighths of an inch.

Test. Brit. tab. 13, fig. 1.

Found by Mr Montagu in a wood in Devonshire, and by Mr Laskey near Musselburgh, Haddingtonshire.

Lævigata,

33. *Lævigata.* Shell thin, fragile, flesh-coloured with three volutions; the first extremely large, the others very small, scarcely produced and placed laterally; wrinkled transversely, striated longitudinally; epidermis brown, rising into membranaceous ridges; mouth sub-orbicular, large, margin thin; diameter about three quarters of an inch.

Brit. Zool. tab. 86. fig. 139.

Brit. Shells, tab. 105.

Found sparingly upon the English shores; more plentifully on the Scottish coast, and in Orkney and Zetland.

Glutinosa,

34. *Glutinosa.* Shell thin, diaphanous, sub-orbicular; whorls three, the body whorl occupying almost the whole of the shell; mouth oval, large, extending nearly to the apex; length rather more than half an inch, breadth three eighths.

Test. Brit. tab. 16. fig. 5.

Found by Mr Boys in marshes at Deal, and by Mr Montagu in a water course near Reading in Berkshire.

Striata,

35. *Striata.* Shell, greenish white, pellucid; mouth oval, with three spires reflected on the back.

Test. Min. Rar. tab. 1. fig. 29.

From Sandwich; very rare.

Variegata.

36. *Variegata.* Shell sub-pellucid, smooth, with red lines; whorls four, the first ventricose; margin of the aperture very much spread.

Adam's on *Lin. Trans.* vol. iii. page 67.

Found by Mr Adam on the coast of Pembrokeshire.

Genus XVII. Nerita.

XVII. Nerita.

Shell subglobose, depressed beneath; mouth semicircular; pillar nearly transverse and flat.

Obs. In this genus the pillar is obliquely truncated, so that the opening is, in general lunated. Latreille and Lamarck have separated the genus Natica from that of Nerita. The Naticæ are distinguished by having a pillar cavity, and in being destitute of teeth. Those species are retained in the genus Nerita, which have an imperforated base, with the pillar sometimes furnished with teeth. As there are so few true Neritæ British, we will, for the present, retain the Naticæ along with them, and merely subdivide the genus.

A. Base imperforated. Nerita.

Littoralis,

1. *Littoralis.* Shell thick, strong, variously colour-

Univalves. ed; whorls five, the first large, the others small and placed laterally; mouth sub-orbicular; margin thickened within, the edge sharp; length three quarters of an inch.

Brit. Zool. tab. 87. fig. 143.
Brit. Shells, tab. 20. fig. 2.

Extremely common on all the British shores, creeping on stones a little below high water mark.

Fluviatilis, 2. *Fluviatilis.* Shells sub-pellucid, sub-oval, elegantly spotted; whorls three, the first very large, the others small, but well defined and placed laterally; apex minutely small; mouth lunated; outer lip thin; pillar lip broad, flat, and white; length three-eighths of an inch.

Brit. Shells, tab. 16. fig. 2.

Found in England in slow running rivers adhering to stones.

B. Base perforated. NATICA.

Glaucina, 3. *Glaucina.* Shell strong, smooth, glossy, variously coloured; whorls six, the first ventricose; apex pointed; mouth suboval, outer lip thin, even; pillar lip thick, reflected, forming a large and deep pillar cavity; length an inch and a half.

Brit. Zool. tab. 87. fig. 141.
Brit. Shells, tab. 20. fig. 1.

On the British shores, common, from Devonshire to Zetland.

Canrena, 4. *Canrena.* Shell resembling the last, but in this the pillar cavity is furnished with two spiral ridges and two grooves; diameter about half an inch.

British Shells, tab. 167. *N. intricata.*

First noticed as British by Mr Donovan, whose specimens are from Weymouth.

Nitida, 5. *Nitida.* Shell ovate, white, smooth, shining; spire short; mouth oval, gibbous beneath; the pillar cavity half closed; diameter scarcely half an inch.

Brit. Shells, tab. 144.

First ascertained to be British by Mr M'Leay, who found small specimens on the coast of Caithness, and we have observed it at St Andrew's, Fifeshire, and in Zetland.

Pallidula, 6. *Pallidula.* Shell sub-pellucid, light brown, with three whorls, the first very large; epidermis rough, brown; mouth semilunated, outer lip thin, fringed by the epidermis; pillar lip thick, white, concave, and perforated; inside glossy; length scarcely half an inch.

Brit. Shells, tab. 16. fig. 1.

In England rather rare. Common on the Scottish coast, in Orkney and Zetland.

Tuberosissima, 7. *Tuberosissima.* Shell pellucid, white, with four whorls; on the body whorl are four elevations broken into tubercles; pillar cavity large; diameter one eighth of an inch.

Test. Brit. tab. 29. fig. 5.

Found by Mr Laskey in the Frith of Forth.

Rufa, 8. *Rufa.* Shell smooth, glossy, of a livid purplish colour, with a white band round the top of the volutions, and two others on the body whorl; diameter more than half an inch.

Test. Brit. tab. 30. fig. 3.

Found near Dunbar, Haddingtonshire, by Mr Laskey.

Pellucida, 9. *Pellucida.* Shell smooth, pellucid, with three volutions.

Lin. Trans. vol. iii. page 67.

Found by Mr Adams on the Pembrokeshire coast.

Alba, 10. *Alba.* Shell smooth, sub-pellucid, with two volutions.

Lin. Trans. vol. iii. page 67. Univalves.

Found by Mr Adams along with the preceding species. These two species are probably the fry of N. glaucina.

GENUS XVIII. TROCHUS.

XVIII. Trochus. *Shell more or less conical; aperture somewhat angular, transversely contracted, with an oblique axis.*

Obs. Lamarck has separated from this genus those shells which have the pillar cavity crenulated or denticulated at the margin of the windings, and those which have a round opening with the two margins disunited, and a pillar truncated at the base forming a tooth projecting into the opening. The former he terms *Solarium,* the latter *Monodonta.*

A. Base perforated.

1. *Magus.* Shell with five or six tumid, sub-depressed whorls, well divided by the separating line, and wrought with fine spiral ridges; mouth compressed, angulated; pillar cavity large, deep, and grooved; diameter about an inch. Magus,

Brit. Zool. tab. 80. fig. 107.
Brit. Shells, tab. 8. fig. 1.

Not uncommon on the British shores from Devonshire to Zetland.

2. *Cinerarius.* Shell irregularly conical, spirally striated, with four or five volutions not much raised; colour cinererius marked with undulated lines of brown; mouth angulated; pillar cavity small but deep; inner lip a little reflected; diameter about five-eighths of an inch. Cinarerius,

Brit. Shells, tab. 74. the upper and two lower figures.

On the British coast common.

3. *Umbilicatus.* Shell strong, flattish, rounded at the top, not pointed; whorls five, nearly even, with obsolete striæ waved with lines of a light or dark purple; mouth compressed, angulated; pillar cavity large, deep; diameter three quarters of an inch. Umbilicatus,

Brit. Zool. tab. 80. fig. 106.

Found in similar situations with the last, and equally abundant.

4. *Tumidus.* Shell strong, subconic, tumid, with four whorls, wrought with fine close set spiral striæ, interrupted only by a deep separating line; body whorl flattened and subcarinated; pillar cavity small, and in old specimens frequently closed; mouth sub-quadrangular; diameter about a quarter of an inch. Tumidus.

Test. Brit. tab. 10. fig. 4.

On the English shores rare. Plentiful in Orkney and Zetland.

5. *Terrestris.* Shell thin, conic, with six flat longitudinally striated whorls, with a prominent ridge at the base of each; mouth compressed angulated; base flat, perforated, striated from the centre. Terrestris,

Brit. Zool. tab. 80. fig. 108.
Brit. Shells, tab. 111.

Found by Hudson on the mountains of Cumberland, and by Mr Morton in Northamptonshire.

6. *Fuscus.* Shell five spired, marginated, aperture roundish, with a pillar cavity. Fuscus,

Test. Min. Rar. tab. 2. fig. 58.

From Sandwich, common; Mr Walker.

B. Base imperforated.

7. *Crassus.* Shell subconic, with five rounded volutions, closely set with zigzag lines; mouth rounded Crassus,

Univalves. on the outer lip, angulated at bottom, with a toothlike protuberance; pillar lip smooth, white; diameter about an inch.

Brit. Shells, tab. 71. *T. lineatus.*

Frequent on the English coast. Mr Laskey found it at Dunbar.

Tenuis, 8. *Tenuis.* Shell thin, fragile, conical, with fine granulated ridges on each whorl; pillar reflects a little; diameter an inch and a quarter.

Brit. Shells, tab. 127. *T. papillosus.*

First described by Da Costa, who received it from Cornwall. Dr Pulteney has found it at Poole and Weymouth.

Ziziphinus, 9. *Ziziphinus.* Shell conic, pointed, with seven or eight whorls, wrought with several spiral ridges; aperture compressed angulated; inside nacred; base flattish.

Brit. Zool. tab. 80. fig. 103.

Common on the British shores and in Orkney and Zetland.

Exiguus, 10. *Exiguus.* Shell conic, with six volutions, pointed; each whorl wrought with four or five small, spiral crenated ridges, with a larger one at the base; aperture angulated; inside white; length three eighths of an inch; breadth a quarter of an inch.

Brit. Shells, tab. 8. fig. 2. *T. conulus.*

Not uncommon on the English coast.

Striatus. 11. *Striatus.* Shell conic, pointed, with six flat volutions, scarcely defined by any separating line, each wrought with eight or nine spiral ridges, intersected by very small longitudinal striæ.

Brit. Shells, tab. 155, fig. 1. *T. conicus.*

Found on the English coast, not frequent.

The claims of *T. cinereus* to admission among British shells are too feeble to warrant its insertion in the present list.

Family III. CONVOLUTED.

The shells of this family have a lengthened mouth, parallel with the length of the shell. The whorls, which are small segments of large circles, are wrapt round the pillar, and do not rise one above another, but embrace or inclose one another. Three genera are included, *Cyprea*, *Voluta*, and *Bulla*.

Genus XIX. Cypræa.

XIX. Cypræa. *Shell ovate, convex; margin involuted; spire small, and nearly covered over; mouth linear, extending the whole length of the shell, and toothed on both sides.*

Europæa, 1. *Europæa.* Shell oval, glossy, tumid, surrounded transversely with elevated striæ, which terminate within the lips, giving them a crenated appearance; colour pale purple, with generally three dark spots on the back; lips white.

Brit. Zool. tab. 70, fig. 82. *C. pediculus.*

Brit. Shells, tab. 43.

This species, which is common on our coast, is subject to great variations in different stages of its growth. In its youngest state, it is pellucid white, with three very small volutions; mouth suboval, outer lip attenuated, inner lip plain. This is the *Bulla diaphana* of *Test. Brit.* and *Voluta Ionensis* of *Brit. Zool.* In another stage of its growth, the back is still smooth, the edges of the lips crenated, and the apex a little produced. This has been termed *C. bullata.* Those species in which the dorsal striæ are distinct, but in which the spots are wanting, have been called *C. arctica.*

Voluta. 2. *Voluta.* Shell conoid, of a pale greenish colour, smooth, glossy, with the outer lip white; extreme volutions two, very small; mouth linear, terminated by a groove; both lips denticulated, the inner one faintly; pillar subplicated; length about half an inch.

Test. Brit. tab. 6, fig. 77.

Found by Mr Montagu in Salcomb Bay, and by Mr Laskey near Dunbar.

Genus XX. Voluta.

Shell ecaudated; mouth extending nearly the whole length of the shell; pillar twisted or plaited, without an interior lip or perforation. XX. Voluta.

1. *Tornatilis.* Shell with eight spires, the first large, the others small, pointed, of a pale purplish red, striated spirally, with two white bands on the body whorl; mouth long and narrow; pillar with one fold; length three quarters of an inch. Tornatilis,

Brit. Zool. tab. 71, fig. 86.

On the English and Scottish coasts not uncommon.

2. *Pallida.* Shell smooth, glossy, white, cylindrical; upper volution small; apex obtuse; mouth narrow, spreading a little at the base; pillar with four folds; length half an inch; breadth a quarter. Pallida,

Brit. Shells, tab. 66.

First noticed by Da Costa, who received it from the western coast.

3. *Denticulata.* Shell with seven or eight volutions, pointed, the lower one large; mouth oblong, oval, half the length of the shell; outer lip furnished with two or three tubercles near the margin; pillar plaited with three or four folds; length half an inch; breadth a quarter. Denticulata,

Test. Brit. tab. 20, fig. 5.

Found by Mr Montagu in Devonshire, at Weymouth by Mr Bryer, and at Dunbar by Mr Laskey.

4. *Alba.* Shell oval, white, with four finely striated volutions; mouth long and narrow, with four plications on the pillar; length one-tenth of an inch. Alba,

Test. Min. Ra. tab. 3, fig. 61.

From Sandwich and Sheppy island, Mr Walker; and Dunbar, Mr Laskey.

5. *Catenata.* Shell oblong, strong, pellucid, white, glossy, with four bands of opaque, white, oblong spots; upper volution scarcely defined; mouth the whole length of the shell, linear; outer lip thick; pillar quadruplicated; length a quarter of an inch; breadth at the top one-eighth. Catenata,

Test. Brit. tab. 6, fig. 2.

Found by Mr Swainson in St Austle Bay, near Fowey, Cornwall; and by Mr Laskey at Dunbar.

6. *Triplicata.* Shell ovate, smooth, chesnut brown, with six spires, the first very large; mouth contracted; pillar triplicated; spires very flat; length scarcely half an inch. Triplicata,

Brit. Shells, tab. 137.

Inserted as British, on the authority of a manuscript note of Da Costa's.

7. *Bidentata.* Shell strong, thick, pure white, with six or seven moderately smooth and somewhat glossy volutions, wrought with a few distant longitudinal wrinkles; mouth narrow, contracted at the upper angle; pillar much thickened, and folding back forms a cavity, and is furnished with teeth-like plications; length a quarter of an inch. Bidentata,

Test. Brit. tab. 29, fig. 3.

Found by Mr Laskey at Dunbar, Haddingtonshire.

8. *Hyalina.* Shell pellucid, white, tapering to an obtuse point; mouth contracted, base truncated and Hyalina,

Univalves.

canaliculated; outer lip smooth; pillar plain, with seven or eight thread-like striæ; length a quarter of an inch.

Test. Brit. tab. 29. fig. 5.

Found by Mr Laskey near Dunbar.

Heteroclita.

9. *Heteroclita.* Shell glossy, white, veined like ivory in a longitudinal direction, and furnished with eight or nine reversed whorls obtusely pointed; pillar with one plication; length a quarter of an inch; breadth one-third of its length.

Mem. Wer. Soc. vol. i. tab. 8, fig. 12.

Found by Mr Laskey near Dunbar.

We consider the *V. bullaoides* as scarcely entitled to a place among British shells.

XXI. Bulla.

Genus XXI. Bulla.

Shell convoluted; spires usually concealed; mouth longitudinal, somewhat contracted; the base entire; pillar smooth; lip acute.

A. Dextral.

Lignaria,

1. *Lignaria.* Shell oval, thin, brittle, yellowish brown, with numerous spiral striæ; mouth extending the whole length of the shell, contracted a little at the upper part; apex depressed; pillar visible to the end; length sometimes nearly two inches.

Brit. Zool. tab. 70, fig. 83.

Brit. Shells, tab. 27.

Found at Weymouth, Dorset, and in Cornwall and Devonshire; rare. It is common in Scotland, at St Andrew's, in the Frith of Forth, and has likewise been observed in Orkney.

Ampulla,

2. *Ampulla.* Shell oblong, smooth, glossy, mottled with light chesnut; no external volution, but the apex is sunk into a considerable cavity; mouth moderately wide; on the lower end of the pillar lip the shell is thickened, and of an opake white colour; pillar not visible to the end; length three-eighths of an inch.

Test. Brit. tab. 7, fig. 1.

Found by Mr Montagu in sand from Falmouth harbour; but rare.

Patula,

3. *Patula.* Shell smooth, glossy, white, oblong, the upper end extending beyond the body; base more extended; mouth large, terminating in a short canal at each end; pillar twisted, forming a furrow on its lip; outer lip plain and very thin; length one inch; breadth half an inch.

Brit. Zool. tab. 70, fig. 85, A.

Brit. Shells, tab. 143.

Found at Weymouth, according to Mr Pennant and Dr Pulteney. Mr Laskey has likewise found it on Portobello sands, near Edinburgh.

Aperta,

4. *Aperta.* Shell sub-orbicular, thin, pellucid, white, without any external convolution or pillar cavity, inner ip very small, slightly involuted, visible to the end; he mouth occupies nearly the whole of the shell. Length about half an inch.

Brit. Shells, tab. 120. fig. 1.

Test. Brit. vig. 2. fig. 1.

First noticed as British by Da Costa. Found in several places on the English shores; and at Dunbar by Mr Laskey.

Plumula,

5. *Plumula.* Shell ovate, oblong, depressed, pellucid; the convolution makes one turn; it is strongly wrinkled, and possesses two or three ray-like indentations running from the margin towards the apex; mouth extends the whole length of the shell; length half an inch.

Test. Brit. tab. 15. fig. 9.

Found by Mr Montagu at Milton sands, South Devon.

Catena,

6. *Catena.* Shell pellucid, white, glossy, transversely striated; apex obtuse without any visible whorl; mouth very large, occupying almost the whole of the shell except a small part at the top; diameter rarely exceeding one-tenth of an inch.

Test. Brit. tab. 7. fig. 7.

Found by Mr Montagu among sand in Bigberry bay Devon; at Tenby South Wales by Mr Adams, and at Dunbar by Mr Laskey.

Emarginata,

7. *Emarginata.* Shell pellucid, smooth; lip subarcuated.

Lin. Trans. vol. v. tab. 1. fig. 9—11.

Found by Mr Adams near Pembroke.

Denticulata,

8. *Denticulata.* Shell white, pellucid, oblong, nearly equal, obtuse, smooth, the mouth at top ending in a very acute tooth.

Lin. Trans. vol. v. tab. 1. fig. 3, 4, 5.

Found near Pembroke by Mr Adams.

Hydatis,

9. *Hydatis.* Shell oval, sub-pellucid, thin; epidermis ferruginous; body tumid, minutely striated transversely; no external volution, apex with a cavity; mouth large at the base, contracting a little at the top and extending rather beyond it; outer lip very thin, pillar lip a little thickened and whitish; pillar not visible to the end: length one inch.

Brit. Shells, tab. 88.

Not uncommon on the western coast of England; it has likewise been observed at Dunbar by Mr Laskey.

Akera,

10. *Akera.* Shell thin, elastic, horn-coloured, oval, somewhat wrinkled longitudinally; apex obtusely canaliculated; mouth large at the base, much contracted at the top; outer lip very thin; pillar lip a little thickened, white; inside white; pillar visible to the end; length about three quarters of an inch; breadth nearly half an inch.

Brit. Shells. tab. 79. *B. resiliens.*

First observed as British by the Rev. Mr Cordiner at Banff; has since been found on several parts of the British coast.

Cylindracea,

11. *Cylindracea.* Shell slender, cylindrical, smooth, glossy, white; aperture the whole length of the shell, narrow and dilated a little at the base; apex depressed, with a cavity; outer lip thin, acute, straight; inner lip thickened, opake, white; pillar a little indented. Length five-eighths of an inch.

Test. Brit. tab. 7. fig. 2.

Brit. Shells. tab. 120. fig. 2. 2.

Not uncommon on the English and Scottish shores.

Umbilicata,

12. *Umbilicata.* Shell oblong, oval, smooth, white; apex rounded with a cavity; mouth narrow, the whole length of the shell, dilating a little at the base; length one-eighth of an inch; breadth one half of its length.

Test. Brit. tab. 7. fig. 4.

Discovered by Mr Montagu amongst sand from Falmouth harbour sparingly.

Truncata,

13. *Truncata.* Shell subcylindric, opake, white, the upper part longitudinally striated, the lower plain; apex truncated with a cavity shewing the involutions; mouth the whole length of the shell, narrow, dilated a little at the base, and contracted in the middle. Size of the last.

Test. Brit. tab. 7. fig. 5.

Common to the shores of Cornwall and Zetland.

Obtusa,

14. *Obtusa.* Shell moderately strong, sub-cylindric, opake, wrinkled longitudinally; apex convoluted, obtuse; whorls four or five, very little produced; mouth

Univalves.

nearly the whole length of the shell, dilated at the base; inner lip thickened, smooth, white; length two-tenths.

Test. Brit. tab. 7. fig. 3.

On the English coast frequent. Very common in the Forth about Bo-ness.

Flexilis,

15. *Flexilis.* Shell pellucid, horn-coloured; apex white and opake, with a one-turned spire. Length half an inch.

Mem. Wer. Soc. vol. 1. tab. 8. fig. 6.

Found by Mr Laskey at Dunbar. Probably belongs to the genus Sigaretus.

B. Sinistral.

Fontinalis,

16. *Fontinalis.* Shell glossy, pellucid, horn-coloured, the body whorl large, the others very small; apex blunt; mouth oblong; length half an inch, breadth a quarter.

Lin. Trans. vol. 8. tab. 4. fig. 1.

In stagnant pools in England and Scotland common.

Rivalis,

17. *Rivalis.* Shell ovate, pellucid, with five spires, with an acute apex; mouth ovate oblong; length half an inch.

Lin. Trans. vol. viii. tab. 4. fig. 2.

First discovered by Mr James Hay in Hampshire. It has been found by Dr Leach in Duddingstone Loch near Edinburgh.

Hypnorum.

18. *Hypnorum.* Shell with five or six taper, smooth, glossy spires; the body whorl half the length of the shell; mouth narrow at the top, spreading a little at the base; outer lip extremely thin; pillar lip a little thickened; length five-eighths of an inch.

Lin. Trans. vol. viii. tab. 4. fig. 3.

Found in ponds and ditches in England.

DIVISION II. MULTILOCULAR.

The shells included in this Division are more complicated in their structure than those of the preceding species. They possess a cavity divided into compartments with a pipe of communication. All the British species are minute, and require the aid of the microscope for their examination. Although the species which are found in a recent state on our shores are very small, many species of a large size occur in the mineral strata, and indicate that the testacea of a former period of the earth's existence differed materially from the species which now exist. To this division of shells only four genera belong, the Nautilus, Orthoceres, Spirolina, and Miliola.

Genus XXII. Nautilus.

XXII. Nautilus.

Shell spiral, discoid; cavity divided into compartments by means of transverse septa or partitions, concave outward, and perforated by a tube.

Obs. This genus will, for the present, include several species belonging to other genera in the system of Lamarck. In a general system, the Gallican genera are unexceptionable, but in a limited description of species, its application would be attended with considerable inconvenience.

Beccarii,

1. *Beccarii.* Shell white, pellucid, with four or five volutions, with deep sulcated joints, ten in the first spire; above convex, beneath flat, and the markings less distinct; mouth turned upwards, not clasping the body whorl; syphon situated at the anterior side close to the second whorl.

Test. Min. Rar. tab. 3. fig. 63.

Test. Brit. tab. 18. fig. 4.

Frequent on the British shores, residing in *algæ* and shells.

Beccarii perversus,

2. *Beccarii perversus.* In every respect resembling the last, with the exception that the spires in this are reversed, or the shell is sinistral.

Test. Min. Rar. tab. 3. fig. 64.

More frequent than the preceding species.

Crispus,

3. *Crispus.* Shell with lateral whorls, furnished with about twenty flexuous crenated joints in the exterior whorl, marked by elevated striæ; outer edge carinated; inner whorl concealed; mouth clasping the body, semicordate, and furnished with a small perforation or syphon.

Test. Brit. tab. 18. fig. 5.

Test. Min. Rar. tab. 3. fig. 65.

Frequent on the English shores.

Lævigatulus,

4. *Lævigatulus.* Shell pale, ferruginous, opake, smooth, with about ten visible flexuous rays of a deeper colour which mark the septa; both sides convex declining to a marginal edge; mouth surrounded with a margin forming a triangle; syphon near the exterior angle.

Test. Min. Rar. tab. 3. fig. 67.

Test. Brit. tab. 18. fig. 7. 8.

Found by Mr Walker at Sandwich and Sea Salter, but not common.

Calcar,

5. *Calcar.* Shell smooth, with six joints on the body whorl, marked by as many flexuous elevated striæ radiating from the centre; back strongly carinated; both sides equally convex; interior volutions lost after entering the aperture, which is semicordate, clasping the body equally on both sides, and furnished with a small perforation.

Test. Brit. tab. 15. fig. 4.

Found by Mr Montagu on the English coast.

Lobatulus,

6. *Lobatulus.* Shell roundish or oblong; above convex, with six or seven lobes, beneath flat; the interior volution only marked by one or two small elevations, and frequently not visible; aperture minutely small; diameter about a line.

Test. Min. Rar. tab. 3. fig. 71.

Found in Kent and Devonshire. Sessile adhering to Algæ.

Concameratus,

7. *Concameratus.* Shell sub-orbicular, compressed, flat beneath, slightly convex above, with three irregular volutions and numerous dissimilar concamerations; the exterior whorl has about nine glossy tumid cells of unequal size; diameter half a line.

Test. Brit. sup. page 168.

Found by Mr Montagu in similar situations with the former.

Depressulus,

8. *Depressulus.* Shell semi-pellucid, glossy, white, depressed, with about nine visible septa, radiating from the centre in curved lines marked by their opacity; sides similar; the mouth is somewhat like N. calcar, but does not clasp the body so much.

Test. Min. Rar. tab. 3. fig. 68.

Test. Brit. tab. 18. fig. 9.

Found at Reculver, very rare, Mr Walker.

Umbilicatulus,

9. *Umbilicatulus.* Shell compressed, sub-pellucid, white, with nine or ten raised joints; the anterior end or mouth clasping the body; whorl nearly equal, within which any interior volution is lost.

Test. Brit. tab. 18. fig. 1.

Found at Sandwich by Mr Walker, and at Kingsbridge by Mr Montagu.

Crassulus,

10. *Crassulus.* Shell spiral, strong, opake, pale brown, with numerous close-set elevated joints; sides compressed, similar, with a central cavity, shewing part

Univalves.

of the interior volution; mouth oblique, scarcely clasping the body.

Test. Min. Rar. tab. 3. fig. 70.
Test. Brit. tab. 18. fig. 2.

On the English coast, rare.

Lacustris,

11. *Lacustris.* Shell compressed, subcarinated, spiral, smooth, glossy; horn-coloured; above convex; apex depressed with three visible volutions; these are bordered on their outer edge with an opake whitish line; under side flat with a deep cavity; chambers distant; mouth narrow, subcordate, clasping the body whorl; diameter nearly a quarter of an inch.

Phil. Trans. vol. xvi. tab. fig. 1—7.
Test. Min. Rar. tab. 1. fig. 28.
Test. Brit. tab. 6. fig. 3.

In marshes and ditches in England not uncommon.

Carinatulus,

12. *Carinatulus.* Shell oblong, carinated, with a narrow oval aperture; colour whitish, transparent like glass.

Test. Min. Rar. tab. 3. fig. 72.

From Seasalter and Sandwich, very rare; Mr Walker.

Inflatus,

13. *Inflatus.* Shell opake, brown, with three lobated whorls; in the first whorl are five extremely ventricose articulations; anterior end sub-globose; syphon placed as in N. beccarii.

Test. Brit. tab. 18. fig. 3.

Found amongst sand on the coast of Devon by Mr Montagu.

XXIII. ORTHOCERA.

Genus XXIII. Orthocera.

Shell straight, or slightly bent, rather conical, the chambers separated by transverse septa, which are pierced by a tube.

Recta,

1. *Recta.* Shell straight, or a little arcuated, with smooth joints; smaller at the posterior extremity than at the mouth.

Test. Min. Rar. tab. 3, fig. 74.
Test. Brit. tab. 19, fig. 4 and 7. Nautilus.

Found at Sandwich by Mr Boys; very rare.

Radicula,

2. *Radicula.* Shell sub-conic, elongated, with eight or nine sub-globose articulations; smooth, opake, brown; aperture a small syphon.

Test. Brit. tab. 6. fig. 4, and tab. 14, Fig. 6. Nautilus.

This species varies much in shape. Found at Sandwich by Mr Boys.

Subarcuata,

3. *Subarcuata.* Shell sub-cylindric, sub-arcuated, with three conspicuous globose articulations at the larger end, the remaining joints being scarcely visible; mouth a small produced syphon; colour pellucid, glossy, white; length a tenth of an inch.

Test. Brit. tab. 6. fig. 5. Nautilus.

Found at Sandwich by Mr Boys.

Jugosa,

4. *Jugosa.* Shell sub-arcuated, sub-cylindric, a little tapering, with nine ridged globose articulations; mouth extended to a small conical syphon; the extreme joint at the smaller end longer than the others near it; length about the eighth of an inch.

Test. Brit. tab. 14, fig. 4. Nautilus.

Found by Mr Boys on the Kentish coast.

Costata,

5. *Costata.* Shell straight, sub-cylindric, a little tapering, with twelve raised articulations, furnished with four equidistant, strong longitudinal ribs running the whole length of the shell; mouth extended in a conical syphon; length a quarter of an inch.

Test. Brit. tab. 14, fig. 5. Nautilus.

Found on the Kentish coast by Mr Boys.

Legumen,

6. *Legumen.* Shell sub-arcuated, smooth, glossy, compressed, and nearly of equal size throughout; the ends are rounded, and a little contracted; the anterior end surrounded with an oblique margin above, which rises into an obtuse syphon; chambers eight or nine in number, with oblique septa; length an eighth of an inch.

Test. Min. Rar. tab. 3, fig. 74.
Test. Brit. tab. 19, fig. 6.

Found in sand on the coast of Kent and South Devon, by Mr Montagu.

Spinulosa,

7. *Spinulosa.* Shell with three extremely globose articulations of a pale chesnut colour, covered with spines; the superior bulb a little elongated, to form the syphon; the spires all incline to the posterior end; length one-tenth of an inch.

Test. Brit. tab. 19, fig. 5. Nautilus.

Found by Mr Boys.

Bicarinata,

8. *Bicarinata.* Shell sub-cylindric, arcuated, with eleven sub-globose bi-carinated articulations; the joints gradually decrease a little to the posterior end, which is rounded; length one eighth of an inch.

Test. Brit. Sup. page 86. Nautilus.

Found by Mr Boys at Sandwich. It resembles in shape the O. subarcuata.

Linearis.

9. *Linearis.* Shell straight, linear, a little compressed, and nearly of equal size throughout; furnished with faint ribs at the lesser end, which take an oblique direction, and scarcely extend half the length of the shell; chambers about fourteen in number; anterior end smooth, with a produced syphon, posterior end rounded; length a quarter of an inch.

Test. Brit. tab. 30, fig. 9. Nautilus.

Discovered by Mr Montagu amongst a parcel of minute shells sent to him from Dunbar by Mr Laskey.

XXIV. SPIROLINA.

Genus XXIV. Spirolina.

Shell in part spirally convoluted; the turns contiguous; the last whorl produced, and straight at the end; chambers divided by transverse perforated septa.

Semilitua,

1. *Semilitua.* Shell elongated, sub-arcuated, with elevated joints; apex incurvated; mouth with a small produced syphon; colour opake, brown.

Test. Brit. tab. 19, fig. 3. Nautilus.

On the English coast.

Subarcuatula.

2. *Subarcuatula.* Shell sub-arcuated; anterior part of the shell with about four chambers, posterior half convoluted; back carinated, and slightly indented at the division of the cells; front margin obtusely rounded; length one-eighth of an inch.

Test. Brit. tab. 19, fig. 1.
Test. Min. Rar. tab. 3, fig. 73. Nautilus.

From Shippy island, very rare, Mr Walker.

XXV. MILIOLA.

Genus XXV. Miliola.

Shell transverse, ovate-globose or elongated, with transverse chambers involving the axis, and in three directions; the opening small at the base of the last chamber.

Obs. The species which we have included in this genus, belong to the genus Vermiculum of Mr Montagu. He separated them from the genus Serpula of Linnæus, from the circumstance of their being independent, or not attached to other bodies. Their multilocular cavity point out their connection with the shells we have been just now treating of, so that we have willingly adopted the genus which Lamarck formed for their reception.

Bicornis,

1. *Bicornis.* Shell white, opake, with three chambers, the middle one small, the outer ones rounded and

Univalves. larger; suboval, compressed, and striated longitudinally on the longer side from the aperture; mouth small, orbicular; length one line.

Test Min. Rar. tab. 1, fig. 2.

Found by Mr Boys at Sandwich and Reculver.

Perforata, 2. *Perforata.* Shell semilunar, perforated; colour white, opake, glossy.

Test. Min. Rar. tab. 1, fig. 3.

Found at Sandwich and Cornwall. Probably a mutilated specimen of the preceding.

Intorta, 3. *Intorta.* Shell oval, compressed, opake, glossy, composed of three and sometimes four compartments, inner ones small; wrinkled transversely; aperture compressed semilunar; diameter one-tenth of an inch.

Test. Min. Rar. tab. 1, fig. 1.

On the British shores frequent.

Subrotunda, 4. *Subrotunda.* Shell sub-orbicular, sub-compressed, smooth, glossy, opake; chambers three, the middle one elevated above the others on the upper side, but not visible beneath; mouth small, angulated; margin in live shells yellow; diameter about half a line.

Test. Min. Rar. tab. 1, fig. 4.

Found among small sand, on the English shores common.

Oblonga. 5. *Oblonga.* Shell oblong, compressed, opake, glossy, white; on one side, the shell is divided into two parts by a single longitudinal suture; on the other side, the middle compartment is surrounded with a faint depression, that separates it from the exterior one, and is more elevated; mouth a little produced, oval, margin yellow; length not half a line.

Test. Brit. tab. 14, fig. 9.

In sand from Salcomb Bay, Devonshire.

ORDER II. BIVALVES.

Bivalves. This order of testaceous bodies was invented by Aristotle, and has been adopted by succeeding conchologists. It consists of an assemblage of shells which are composed of two concave plates, united laterally to each other by means of a hinge. The genera may be conveniently arranged in two divisions, depending on the form of the hinge. Other characters might be employed in the formation of subsidiary Sections and Families. For instance, the circumstance of the valves being closed or gaping; the shells equilateral or inequilateral, equivalved or inequivalved. The internal or external insertion of the cartilage of the hinge ought to be closely attended to in a general arrangement; but at present we choose to employ such characters as helps merely, in the distribution of species.

DIVISION I. DENTATED.

Dentated. This Division comprehends such shells as are furnished with teeth at the hinge. These teeth vary in number, form, and position, in the different species, and are employed as marks in the construction of the genera.

Genus XXVI. Mya.

XXVI. Mya. *Shell generally gaping at one end, and furnished with strong, broad, thick teeth at the hinge, not inserted into the opposite valve.*

A. Valves Gaping.

Glycymeris, 1. *Glycymeris.* Shell oblong, thick, transversely wrinkled, and gaping at both ends; hinge furnished with a thick primary tooth, and a smaller one, besides a series of wrinkles. Length five inches, breadth nine or ten.

Brit. Shells, tab. 142.

This species is scarcely admissible into a list of British shells. It was introduced by Mr Donovan, merely from the circumstance of its occurring in deep water between the Dogger-bank and the eastern coast of England, and likewise from its being acknowledged as British by some English collectors.

Pholadia, 2. *Pholadia.* Shell thin, opake, of an oval shape, marked with fine concentric striæ; beak small, prominent, and placed at one end; valves, when shut, have a large oval gape in front; hinge furnished with a small plate projecting inwards.

Brit. Zool. tab. 44. fig. 19.

First noticed from Weymouth by Pennant. Found on the Dorset coast by Dr Pulteney also, and on the Devonshire coast by Mr Montagu.

Arenaria, 3. *Arenaria.* Shell oval, moderately concave, rough, with concentric striæ; beaks prominent; hinge with one valve, furnished with a broad, thick, erect tooth, by which it is joined to the toothless valve; the smaller end gapes, and is reflected. Length two inches and an half, breadth nearly four inches.

Brit. Zool. tab. 42. fig. 16.

At the mouth of rivers on the English and Scottish shores, frequent.

Truncata, 4. *Truncata.* Shell truncated at the smaller end where it gapes, and concentrically wrinkled; valves concave and reflected at the smaller end; tooth broad and erect. Length two inches or more, breadth about three.

Brit. Zool. tab. 41. fig. 14.

This species is found lodged under gravel at low water mark, on various parts of the British shores. It is the shell which Pennant should have referred to as the one eaten by the Hebridians. In Orkney and Zetland it is used as a supper dish when boiled, and is called *Smurslin.*

B. Valves Closed.

Margaritifera, 5. *Margaritifera.* Shell ovate-oblong, sub-arcuated opposite the hinge, covered with a black epidermis, usually worn off at the beaks; a single tooth in one valve locks into a bifurcated tooth in the other. Length two inches and a half, breadth five inches.

Brit. Zool. tab. 43. fig. 18.

This shell is found in several rivers of Britain. It lives in those which are rapid, and which flow in mountainous countries. It often produces pearls of a considerable size, and of a good colour.

Ovalis, 6. *Ovalis.* Shell strong, oval, of a dusky green colour, almost black at the smaller end; beaks near the larger end; hinge furnished with one tooth, which locks into a bifurcated tooth in the opposite valve, these are strong and crenated; there are likewise two lateral laminæ in one valve, and one in another. Length two inches, breadth four inches.

Brit. Shells, tab. 101. M. depressa.

——— tab. 121. M. ovata.

Found in England in slow running rivers.

Bivalves.

Pictorum, 7. *Pictorum.* Shell sub-arcuated, olive green, concentrically wrinkled; beak near to one side; hinge nearly straight, from which it declines alike to both ends; a single broad crenated tooth, with two lateral laminæ in one valve, and one in the opposite, lock into each other. Length one inch, breadth an inch and three quarters.

Brit. Shells, tab. 174.

Found by Mr Montagu in the river Kennet, above the town of Newbury, in Berkshire.

Suborbicularis, 9. *Suborbicularis.* Shell sub-pellucid, sub-orbicular, faintly striated transversely; margin opposite the hinge nearly straight; hinge central, with a single tooth immediately under the beak, locking into a double one in the opposite valve, with a laminated tooth behind the beak in each, somewhat remote. Length three-eighths of an inch, breadth half an inch.

Test. Brit. tab. 26. fig. 6.

Discovered by Mr Montagu in limestone at Plymouth, and detached from any other substance in Salcomb Bay. Mr Laskey found it at Dunbar, and we have found it in the Murray Frith, and in Zetland.

Bidentata, 10. *Bidentata.* Shell sub-oval, thin, compressed, dirty white; beak small, placed near to one end, and a little reclined; hinge with two broad erect laminated teeth in one valve. Length one-eighth of an inch, rather more in breadth.

Test. Brit. tab. 26. fig. 5.

Found by Mr Montagu in Salcomb Bay, Devonshire, burrowed in old oyster shells.

Decussata, 11. *Decussata.* Shell ovate, white, with concentric ridges, decussated by regular longitudinal striæ, forming tubercles at the anterior end; margin waved; beak obtuse, recurved, and placed nearest to one end; hinge with a broad erect tooth in one valve, and a projecting indented lamina on the other for its reception. Length nearly half an inch, breadth rather more.

Test. Brit. tab. 28. fig. 1.

Found near Dunbar, where it is rare.

Purpurea, 12. *Purpurea.* Shell ovate, slightly wrinkled transversely, and of a purple colour about the beak, shaded to a white towards the margin; beak placed considerably to one side, and turning towards the shorter end; hinge with a single erect tooth in each valve, slightly bifid. Diameter about a line.

Found by Mr Montagu amongst coralline in deep water on the coast of Devon; very rare.

Ferruginosa, 13. *Ferruginosa.* Shell subovate, moderately convex, white, with obsolete wrinkles; beak obtuse, placed nearest to one end; front margin nearly straight; hinge furnished with two projecting teeth, one of which is erect, the other turns inwards, and slopes downwards; the teeth are separated by a large triangular notch. Length about a quarter of an inch, breadth half an inch.

Test. Brit. tab. 26. fig. 2.

Found by Mr Laskey on the shore near Dunbar. It is probably a native of Weymouth.

Nitens. 14. *Nitens.* Shell ovate, of a pink colour, shaded to white at the shorter end, and regularly striated concentrically; beak prominent, but scarcely central; hinge furnished with a single tooth in one valve, which shuts into a deep cleft between two slight elevations in the other. Diameter about three-eighths of an inch.

Mem Wernerian Soc. vol. i. tab. 8. fig. 4.

Found by Mr Laskey at Dunbar; extremely scarce.

XXVII. Ligula.

Genus XXVII. Ligula.

Shell equivalve; hinge with a broad erect tooth in each valve, projecting inwards, furnished with a pit or cavity for the reception of the connecting cartilage; in some species a minute erect tooth.

Obs. This genus was formed by Mr Montagu for the reception of a few species, which are included by some conchologists in the genera Mya and Mactra.

Prætenuis, 1. *Prætenuis.* Shell oval, thin, brittle, flat, marked with a few concentric striæ; beak small, pointed, turned to one side; valves a little gaping at the smaller end; hinge with a broad tooth in each valve, hollowed in the middle, projecting horizontally inwards; length above half an inch, breadth one inch.

Test. Brit. tab. 1, fig. 2.

Brit. Shells, tab. 176.

Found in several places on the English coast. Mr Laskey found it at Portobello sands, and we have seen it in Zetland.

Pubescens 2. *Pubescens.* Shell thin, brittle, oval, white, truncated at the smaller end; behind the cartilage slope, one valve turns up and embraces the other valve; beak nearly central; hinge, with one broad tooth projecting inwards; length two inches long, and three inches wide.

Brit. Shells, tab. 82.

Brit. Zool. tab. 47, fig. 26. Young.

Found on the Cornwall and Devonshire coast. The young shells are frequent on the Scottish coast as far north as Zetland.

Distorta, 3. *Distorta.* Shell subpellucid, thin, fragile, rugged, and distorted; valves convex; beak small, nearly central; hinge, with a broad subtriangular tooth; length an inch and three quarters, breadth two inches and a half.

Test. Brit. tab. 1, fig. 1.

Found on the coast of Cornwall and Devon by Mr Montagu. It sometimes burrows in limestone.

Compressa, 4. *Compressa.* Shell flat, thin, sub-oval, sub-triangular, concentrically wrinkled; beak small, central; hinge without lateral teeth; primary teeth small, a single one locking into a bifid tooth in the opposite valve; length an inch and a half, breadth two inches.

Pult. *Hutch. Dorset.* tab. 17, fig. 1. Mactra compressa.

Brit. Shells, tab. 64, fig. 1. Tellina plana.

Found in abundance at the mouths of rivers, but never beyond the flux of the tide.

Tenuis, 5. *Tenuis.* Shell equilateral, compressed, subtriangular, semipellucid, thin, concentrically wrinkled; beak small, central, much produced; hinge furnished with a bifurcated tooth in one valve, and a plain tooth in the other, with a remote lateral tooth in each valve; length a quarter of an inch, breadth little more.

Test. Brit. tab. 17, fig. 7.

Found by Mr Montagu at Southampton, by Mr Bryer at Weymouth, and by Mr Laskey at Musselburgh.

Boysii, 6. *Boysii.* Shell oval, flat, thin, pellucid, almost smooth; beak placed near the small end, and a little turned at the apex; hinge, with small primary teeth; cartilage cavity broad; lateral teeth in one valve only, broad, elevated; length half an inch, breadth three quarters.

Test. Brit. tab. 3, fig. 7.

First discovered at Sandwich by Mr Boys. Mr Montagu has likewise found it on the coast of Devon and Dorset. It is likewise common on the Portobello sands near Edinburgh.

Prismatica 7. *Prismatica.* Shell oblong, flat, thin, glossy, white, attenuated at one end, and obsoletely striated concen-

Bivalves. trically; beak small, and placed nearest to the smaller end, to which it turns; hinge furnished with a horizontal tooth, and a minute erect tooth; length three-eighths of an inch, breadth six-eighths.

Test. Brit. tab. 26, fig. 3.

Found by Mr Laskey on the shore at Dunbar. Mr Montagu has likewise found a single valve on the coast of Devon.

Substriata. 8. *Substriata.* Shell sub-ovate, white, sub-pellucid, wrought with distant, obsolete, elevated, longitudinal striæ; beak prominent; hinge furnished with a slight projection inwards, margined so as to form a cavity.

Taken by deep dredging among *Corallines,* on the coast of Devon, by Mr Montagu.

Genus XXVIII. Solen.

XXVIII. Solen. *Shell equivalved, transversely elongated, gaping on each side; the hinge teeth single in each valve, or double in one valve; beaks very small; the ligament external, and most frequently near to the extremity of the shell.*

Siliqua, 1. *Siliqua.* Shell straight, sub-cylindric, truncated at one end, rounded at the other; striated transversely and then longitudinally towards the back; a diagonal line from the hinge to the opposite end marks the turn of the longitudinal striæ; teeth in one valve single, with a remote lateral lamina; in the other valve two teeth, and a lateral inclined one; length an inch, breadth eight inches.

Brit. Zool. tab. 45, fig. 20.

Common on the sandy shores buried to the depth of a foot or more near low water mark. It is an article of food in many places.

Novacula, 2. *Novacula.* Shell resembling the last, except the hinge, in which it differs; the teeth are two in number, one on each valve, strong, blunt, and curved, and hook into each other when the shell is closed; no lateral laminæ; length one inch, breadth eight inches.

Test. Brit. page 47.

Found near Laugharne, Caermarthenshire, by Mr Montagu.

Ensis, 3. *Ensis.* Shell sub-cylindrical, arcuated; hinge, with a single tooth and a lateral lamina in one valve, which lock into two teeth and double laminæ in the opposite valve; length three quarters of an inch, breadth between five and six inches.

Brit. Zool. tab. 45, fig. 22.

Common in similar situations, as the S. siliqua.

Vagina, 4. *Vagina.* Shell cylindric, straight, rather truncated at both ends; the end next the hinge a little reflected; striated transversely, each stria running longitudinally across the shell, but not marked with a diagonal line; hinge close to one end, furnished with a single small compressed tooth in each valve, which lie by the side of each other when closed; length one inch, breadth five inches.

Brit. Zool. tab. 46, fig. 21.

Brit. Shells, tab. 110. S. marginatus.

This shell was first noticed by Pennant from Anglesea. Found at Weymouth by Dr Pulteney, and near Laugharne, Caermarthenshire, and at Kingsbridge, Devonshire, by Mr Montagu.

Pellucidus, 5. *Pellucidus.* Shell oblong, sub-arcuated, pellucid, fragile, compressed, and rounded at each end; hinge near to one end, furnished with a single small tooth in one valve, locking into two in the opposite, with a lateral process in each; length a quarter of an inch, breadth an inch and a quarter.

Brit. Zool. tab. 46, fig. 23.

First described by Pennant from Anglesea. Found in Cornwall, Kent, and Devon, by Mr Montagu. It is common on Portobello sands near Edinburgh. Bivalves.

6. *Legumen.* Shell straight, oblong, pellucid, thin, of a white colour; hinge near the middle, and furnished with two small teeth in one valve, receiving a single one from the opposite; length an inch, breadth four inches. Legumen,

Brit. Zool. tab. 46, fig. 24.

Brit. Shells, tab. 53.

On the English shores, but not common.

7. *Fragilis.* Shell thin, pellucid, fragile, glossy, white, somewhat depressed in the middle from the hinge to the opposite margin, oblong, rounded at both ends; hinge near the middle, furnished with a small subulate tooth in one valve, in the other two, one of which is subulate, the other broad. Fragilis,

Pult. *Dorset.* tab. 5, fig. 5.

Found on Studland beach by Dr Pulteney, at Weymouth by Mr Bryer, and at Dunbar by Mr Laskey.

8. *Antiquatus.* Shell thin, subpellucid, wrought with fine concentric striæ, ends rounded, and gaping; hinge placed near the centre, with a single tooth in one valve, locking in between two in the opposite; these are erect, and project beyond the margin; length one inch, breadth two inches. Antiquatus,

Brit. Shells, tab. 114.

Brit. Zool. tab. 46, fig. 25. S. cultellus.

Mr Pennant first gave this species as a British shell from Weymouth. It has occurred to us in Zetland.

9. *Minutus.* Shell opake, whitish, rugose or wrinkled transversely, sub-oval, truncated at one end near the hinge; valves dissimilar, each furnished with two rows of spines from the beak to the larger end; hinge teeth two in one valve, and one in another, with a small cavity, minute; length half an inch, breadth upwards of an inch. Minutus,

Test. Brit. tab. 1, fig. 4.

This species was observed by Cordiner in the Murray Frith. Mr Montagu has found it burrowed in limestone at Plymouth. In Scotland, it is common among the roots of fuci.

10. *Vespertinus.* Shell ovate, depressed, marked with concentric striæ; beak nearly central, small; teeth two in one valve, and one in another, erect, and likewise a strong projecting lamina in each; length an inch and quarter, breadth two inches and a half. Vespertinus,

Brit. Zool. tab. 47, fig. 27. Tellina depressa.

Brit. Shells, tab. 41, fig. 2.

First figured by Pennant. Found on the Dorset and Devon coasts. Mr Laskey found it at Dunbar.

11. *Squamosus.* Shell flat, pellucid, thin, white, of a sub-orbicular shape, minutely punctured; beak small, pointed, central; teeth two in each valve, double; length three-eighths of an inch, breadth half an inch. Squamosus.

Test. Brit. page 565.

This species has been found only by Mr Montagu in sand, from Salcomb bay, Devonshire.

Genus XXIX. Tellina.

Shell equivalved, orbicular or transverse, with an irregular fold on the anterior part; hinge with one or two teeth, and remote lateral teeth. XXIX. Tellina.

Obs. This genus in the Linnæan system, is in great confusion. The French conchologists, with much propriety, have removed the *Tellina cornea* of Lin. and its congeners into a new genus, which they denominate Cyclas. Mr Montagu has likewise separated these shells

Bivalves.

from the genus Tellina, and inserted them among the *Cardia*. The T. inequivalvis forms another new genus termed Pandora.

Ferroensis,

1. *Ferroensis.* Shell flat, oblong, oval, transversely striated; beak very small, nearly central; hinge furnished with two teeth in each valve; from the beak an oblique elevated ridge runs to one end; length three quarters of an inch, breadth an inch and a half.

Brit. Zool. tab. 47, fig. 31. T. incarnata.

Brit. Shells, tab. 60. T. trifasciata.

Common on the shores of Britain from Cornwall to Zetland.

Squalida,

2. *Squalida.* Shell thin, flat, sub-oval, faintly striated concentrically, the anterior end running into a beak; hinge with two teeth in one valve and three in the other, one of which is a little remote; the small end of one valve reflects a little outwards, and forms a depression on the surface, the other turns inwards to correspond; length an inch, breadth three quarters.

Pult. *Hutch. Dor.* tab. 5. fig. 2.

Brit Shells, tab. 63. T. Depressa.

First noticed as British by Dr Pulteney, who found it near Poole, and at Weymouth, Dorsetshire; Mr Montagu has found it in Cornwall and Devon; Mr Donovan in Pembroke; and Mr Laskey at Dunbar.

Læta,

3. *Læta.* Shell ovate, oblong, flat, and moderately strong, marked with regular concentric striæ; beak small, pointed, nearly central; hinge furnished with three teeth, the outer one on the anterior side bifid, the other exterior one broad; in each valve one remote lateral lamina; length three quarters of an inch, breadth an inch and three-eighths.

Brit. Shells, tab. 23. T. inæquistriata.

On the English shores rare. Found at Dunbar by Mr Laskey.

Donacina,

4. *Donacina.* Shell thin, sub-oval, compressed, semi-pellucid, faintly marked with yellowish concentric striæ, and radiated with red; beak small, and placed near to one end; the cartilage end short and sub-truncated; the hinge is furnished with two teeth in one valve, and a single tooth in the other; length about half an inch, breadth three quarters.

Lin. Trans. vol. viii. tab. 1. fig. 7.

Found on several parts of the English coast, and in Scotland at Dunbar.

Tenuis,

5. *Tenuis.* Shell thin, brittle, flat, sub-pellucid, suboval, with a few concentric wrinkles; beak small, placed nearly central; cartilage end somewhat pointed; variously coloured; length half an inch, breadth three quarters.

Brit. Zool. tab. 48, fig. 49. T. planata.

Brit. Shells, tab. 19, fig. 2.

Common on all the sandy shores of Britain.

Striata,

6. *Striata.* Shell sub-oval, flat, thin, sub-pellucid, of a rosy white colour, darkest towards the beaks, marked with fine concentric striæ; beaks small, pointed, not quite central; cartilage slope indented; primary teeth two, with strong remote laminated ones on each side; length one inch, breadth five-eighths of an inch.

Test. Brit. tab. 27, fig. 2.

Found by Mr Bryer on the beach between Weymouth and Portland.

Fabula,

7. *Fabula.* Shell thin, pellucid, compressed, oval, white; beaks nearly central, small, pointed, and turning a little to one side; anterior side slopes to an obtuse point; the opposite end is much larger and rounded; left valve finely striated in a diagonal direction; hinge with three teeth in one valve, and two in the other; length five-eighths of an inch, breadth an inch.

Brit. Shells, tab. 97.

Not uncommon on sandy shores.

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Similis,

8. *Similis.* Shell ovate, compressed, with both valves diagonally striated five sixths over the surface; beaks not curved; breadth about half an inch.

Brit. Miscel. page 29, tab. 75.

First described by Mr Sowerby. It inhabits the shores of Brighton, in company with T. fabula.

Solidula,

9. *Solidula.* Shell strong, convex sub-orbicular; colour various; beaks near the middle; hinge with two small teeth in each valve; length three quarters of an inch, breadth rather more.

Brit. Zool. tab. 49, fig. 32. T. carnaria.

A common littoral shell. It is often found at the mouths of large rivers, but not beyond the influence of the tide. Thus it occurs in the Tay as far up as Flisk.

Fausta,

10. *Fausta.* Shell sub-orbicular, somewhat compressed, white, with numerous fine concentric striæ; at the posterior end a fissure from the beak to the margin; beak central; hinge furnished with strong lateral teeth; one of the primary teeth in each valve bifid; diameter an inch and three quarters.

Lin. Trans. vol. viii. tab. 1, fig. 8.

Brit. Shells, tab. 98.

Found in Dorsetshire by Dr Pulteney, in Devonshire by Mr Montagu, and in Pembrokeshire by Mr Donovan.

Crassa,

11. *Crassa.* Shell strong, thick, sub-orbicular, with fine close set concentric striæ, interrupted by a few courser ridges; left valve convex, the other more compressed; beak placed a little to one side; hinge with two teeth in each valve, one of which is bifid; in the left valve two lateral teeth, one more remote than the other.

Brit. Zool. tab. 48, fig. 28.

Brit. Shells, tab. 103. T. rigida.

Found on the south coast of England; and at Aberlady bay by Mr Laskey.

Proficua,

12. *Proficua.* Shell sub-orbicular, sub-diaphanous, beset with numerous fine regular elevated ridges, the furrows crossed with minute striæ; beak small, prominent, nearly central; hinge, with two small central teeth, and broad laminated lateral ones projecting above the margin; inside smooth, glossy, yellow, margin plain, beneath which is a punctured line; length an inch and a quarter, breadth somewhat more.

Lin. Trans. vol. viii. tab. 1, fig. 9.

First described as British by Dr Pulteney, who found it at the north shore at Poole, and at Weymouth, Dorsetshire.

Radula,

13. *Radula.* Shell convex, sub-orbicular, white, beset with numerous fine sharp-edged concentric striæ; beak central, small, the apex turned to one side; hinge with two small teeth in each valve, standing a little oblique; breadth about an inch and a half, and nearly the same in length.

Brit. Shells, tab. 130. T. Venus Borealis.

Test. Brit. tab. 2. fig. 12.

On the south coast of England, not common. In Scotland, frequent at Leith, Arran, and Zetland.

Bimaculata,

14. *Bimaculata.* Shell roundish, sub-triangular, faintly striated transversely; beak nearly central, the apex turned a little to one side; primary teeth large, lateral ones strong, remote; length half an inch, breadth five-eighths.

Brit. Shells, tab. 19, fig. 1. 1.

First noticed by Da Costa from the coasts of Hampshire and Lancashire. Dr Pulteny and Mr Bryer procured it at Weymouth.

Lactea,

15. *Lactea.* Shell thin, orbicular, convex, with fine concentric irregular wrinkles; beaks small, central, turn-

Bivalves. ing a little to one side; hinge furnished with two teeth in the one valve, and one in the other; by the side of the teeth in each valve a deep groove, into which the connecting cartilage is fixed; diameter three quarters of an inch.

Test. Brit. tab. 2, fig. 4.

Found on various parts of the English coast.

Rotundata, 16. *Rotundata.* Shell thin, sub-pellucid, orbicular, white, rather convex, wrought with fine concentric striæ; beak nearly central, small, turned to one side; teeth two in each valve, one of which is bifid, the other a little diverging; inside smooth, glossy; diameter about an inch.

Test. Brit. tab. 2. fig. 3.

Found on the shores of Dorset, Devon, and Cornwall.

Flexuosa, 17. *Flexuosa.* Shell thin, pellucid, fragile, convex, sub-orbicular; from behind the beak to the lower angle of the margin, a sulcus runs parallel with the cartilage slope, and forms a flexure at the edge; beak nearly central, much produced, turning to one side; hinge with an obsolete tooth; diameter about three-eighths of an inch.

Brit. Shells. tab. 42. fig. 2. Venus sinuosa.

Found in Cornwall and Devon by Mr Montagu; and at Portobello sands by Mr Laskey.

Carnaria, 18. *Carnaria.* Shell sub-orbicular, flattish, with one side rather longer than the other; striated in three directions; beak small, nearly central, and turning a little to one side; hinge in one valve furnished with two small teeth, one of which is bifid, in the other with one tooth; lateral teeth laminated, remote; length three quarters of an inch; breadth seven eighths.

Brit. Shells, tab. 47.

First noticed by Da Costa, from Yorkshire, Devonshire, and Cornwall. Dr Pulteney found it sparingly at Poole and Weymouth.

Maculata, 19. *Maculata.* Shell sub-ovate, strong, striated longitudinally and transversely; irregularly spotted.

Lin. Trans. vol. iii. p. 252.

Found at Tenbigh by Mr Adams.

Polygona, 20. *Polygona.* Shell sub-ovate, sub-orbicular, wrought with fine concentric striæ which are crossed with very fine lines; beak small, the shorter end is a little truncated and angulated; the larger end is rounded; inside smooth, margin uneven; teeth, in one valve, two large and distant, in the other, one, very large, triangular, bifid tooth, with an approximate small one.

Test. Brit. tab. 28, fig. 4.

Dredged up by Mr Laskey off Cramond Island, in the Frith of Forth.

Laskeyi. 21. *Laskeyi.* Shell ovate, oblong, smooth; beak scarcely central, obtuse; one of the sides rounded, the other obtuse; inside white round the margin, and smooth; in one valve there are two approximate sub-bifid teeth, and the margin channeled from the teeth almost to the end of the longest side, and on the other side of the teeth the margin is replicated; the other valve has only a single tooth; length half an inch; breadth three quarters.

Test. Brit. tab. 28, fig. 3.

Found by Mr Laskey in Aberlady bay and Musselburgh sands, in the Frith of Forth.

Genus XXX. Pandora.

XXX. Pandora. *Shell regular, inequivalved and inequilateral, with two oblong, unequal, and diverging hinge-teeth in the superior valve, and two oblong corresponding pits in the other valve; the cartilage interior; two muscular impressions.*

3

Obs. This genus was formed by Lamarck, for the purpose of separating the Linnæan *Tellina inæquivalvis* from a family of shells with which it is very remotely connected. Bivalves.

1. *Inæquivalvis.* Shell oblong, sub-pellucid, white; left valve nearly flat, the other convex, sub-arcuated along the cartilage slope, and extending into a considerable obtuse beak at that end; the other end round; in the flat valve two diverging teeth, the anterior one small; from the beak to the longest side, a longitudinal depression; length half an inch; breadth one inch. Inæquivalvis.

Brit. Shells, tab. 41, fig. 1, *Tellina inæquivalvis.*

First described as British by Mr Donovan. According to Dr Maton and Mr Rackett, small ones are found on the Kentish coast.

Genus XXXI. Corbula.

Shell transverse, inequilateral, inequivalved, with prominent incurved beaks; hinge with a single conical recurved tooth in each valve; ligament internal; two lateral impressions. XXXI. Corbula.

1. *Inæquivalvis.* Shell subtriangular, strong; under valve deep, and larger than the upper valve; beak prominent, standing high above the hinge; outside covered with a brown epidermis; inside smooth, the margin appearing as if ground to an edge; length three-eighths of an inch. Inæquivalvis.

Test. Brit. tab. 26. fig. 7. *Mya inæquivalvis.*

This shell we have ventured to remove from the *Myæ*, and to place in the genus *Corbula* of Lamarck, with the characters of which it seems most exactly to correspond. It is a very common shell on the English and Scottish shores.

Genus XXXII. Cardium.

Shell equivalved, convex, longitudinally ribbed, with a toothed margin; hinge with two teeth near the beak, and a larger remote lateral one on each side, locking into the opposite valve. XXXII. Cardium.

1. *Edule.* Shell with about twenty-six antiquated ribs, of a yellowish-white colour; the anterior end a little elongated, and generally of a darker colour; greatest diameter about an inch and three quarters. Edule,

Brit. Zool. tab. 50, fig. 41.

Brit. Shells, tab. 124.

This is the common cockle, and is found in great plenty on the British shores, in the sandy bays and inlets.

2. *Aculeatum.* Shell convex, posterior side rounded, the other nearly straight, and more elongated at the front marginal angle; ribs about twenty-one, with a depressed line down the middle; the round end beset with large compressed tubercles, the other part towards the margin with spines; length about four inches. Aculeatum,

Brit. Shells, tab. 6.

Common in various parts of the English and Scottish shores. The young of this species have been long known as *Cardium ciliare.* They are destitute of spines.

3. *Echinatum.* Shell very convex, having about eighteen ribs furnished with numerous close set convex spines; diameter about two inches and a half. Echinatum,

Brit. Shells, tab. 107, fig. 1.

Common on our shores.

4. *Lævigatum.* Shell sub-oval, striated longitudinally, with a few concentric wrinkles; anterior side a lit- Lævigatum,

Bivalves.

tle produced; epidermis yellowish-brown; young shells are finely polished; length two inches and a half; breadth two inches.

Brit. Zool. tab. 51, fig. 40.

Found in several places on the coast.

Nodosum, 5. *Nodosum.* Shell rufous white, flat, sub-orbicular, with twenty-four close set obtuse tubercles; inside white, glossy; diameter three quarters of an inch.

Test. Brit. p. 91.

Discovered in Falmouth, in Cornwall, by Mr Montagu.

Elongatum, 6. *Elongatum.* Shell compressed, suboval, subangulated, with twenty-one ribs faintly wrinkled and rounded; posterior side somewhat elongated and angulated; diameter a quarter of an inch.

Test. Brit. page 82.

Found by Mr Montagu by dredging in Salcomb-bay.

Exiguum, 7. *Exiguum.* Shell convex, sub-triangular, with twenty tuberculated ribs, the interstices strongly striated transversely; length about half an inch.

Brit. Shells, tab. 82, fig. 3.

Found by Mr Montagu in Cornwall and Devon; Mr Boys has found it at Sandwich; Mr Laskey found it at Dunbar; and we have it from Zetland.

Medium 8. *Medium.* Shell sub-triangular, sub-cordated, with about thirty-six smooth ribs; truncated on one side, and running into an angle at the front margin; the other side is shorter, and rounded; primary teeth one in each valve, which, with the lateral ones, are strong and elevated; length about an inch.

Brit. Shells, tab. 32, fig. 1.

First described as British by Mr Montagu, whose specimen was found at Hartlepool, on the coast of Durham.

Rubrum, 9. *Rubrum.* Shell smooth, red, glossy, pellucid, convex; hinge not quite central; rounded at both ends; beak prominent; hinge with nearly obsolete primary teeth, lateral ones very conspicuous; diameter about the eighth of an inch.

Test. Brit. tab. 27, fig. 4.

Found by Mr Montagu on the coast of Devon, and at Dunbar by Mr Laskey.

Discors, 10. *Discors.* Shell convex, sub-orbicular, glossy, white, finely striated in an oblique direction, the striæ curved at the anterior side, the posterior end in a contrary direction, forming an acute angle with the others; beak small, central, turning a little to one side; size of a pea.

Test. Brit. page 84.

Found by Mr Montagu at Falmouth.

Muricatulum, 11. *Muricatulum.* Shell white, opake, heart-shaped, with a muricated margin; minute.

Test. Min. Rar. fig. 84.

Found at Sheppy island.

Arcuatum, 12. *Arcuatum.* Shell thin, fragile, semi-pellucid, orbicular, white, finely striated transversely in an arcuated manner, with a few concentric wrinkles; beak central, pointed at the apex, and turned to one side; hinge, with one primary tooth in each valve; laminated teeth remote; diameter about half an inch.

Test. Brit. tab. 3, fig. 2.

Dredged up in Falmouth harbour by Mr Montagu.

Edentula, 13. *Edentula.* Shell sub-ovate, thin, rounded at one end, and sub-angulated at the other, with a few broad, distant, concentric elevations and longitudinal striæ; beak small pointed; hinge destitute of any primary tooth; length two inches and a half; breadth three inches.

Brit. Shells, tab. 161, *Mactra radiata.*

Found by Mr Laskey at Portsmouth after a storm.

Fasciatum. 14. *Fasciatum.* Shell sub-orbicular, sub-pellucid, with about twenty seven smooth, glossy, flattened ribs, slightly tuberculated at the shorter side; coloured with three or four brown bands; length three-eighths of an inch.

Test. Brit. tab. 27, fig. 6.

Found on the shores of Cornwall, Devon, Leith, and Zetland.

Genus XXXIII. Cyclas.

XXXIII. Cyclas. *Shell almost orbicular, or a little transverse, not inflected on the fore part; the hinge with two or three teeth, and two lateral ones, compressed and rather remote.*

Obs. This genus of Lamarck contains species which chiefly inhabit rivers and pools. The British species have been referred to the genus *Cardium* or *Tellina.* Their smooth surface and uneven margin forbid their insertion in the former, and the want of the fold in the anterior part of the shell, forbid their insertion in the latter genus. The inhabitant bears a close resemblance to the molluscous genus *Tethys.* The three species are viviparous.

Cornea, 1. *Cornea.* Shell thin, pellucid, sub-orbicular, convex, marked with fine concentric striæ; epidermis horn-coloured; beak central, obtuse; hinge with the central teeth very small; the lateral laminated ones remote and prominent; sometimes half an inch long, and three quarters broad.

Brit. Zool. tab. 49, fig. 36, *Tellina cornea.*
Brit. Shells, tab. 96.
Test. Brit. p. 86, *Cardium corneum.*

A common British shell, found in slow rivers and stagnant pools.

Amnica, 2. *Amnica.* Shell thin, sub-pellucid, oblique, suboval, convex, sulcated transversely, and striated longitudinally towards the front; umbo placed nearest to one side; hinge furnished with one central tooth, and two lateral teeth on each side, in one valve, standing parallel one within the other, the outer of which is very small; in the other valve two approximating primary teeth stand oblique, with one lateral tooth on each side; epidermis horn-coloured; length three-eighths of an inch; breadth half an inch.

Brit. Shells, tab. 63. fig. 2, *Tellina rivalis.*

First distinguished as British by Dr Maton. It is a common British shell, inhabiting the same places as the preceding, resembling the above in shape.

Lacustris. 3. *Lacustris.* Shell sub-rhomboidal, thin, pellucid, smooth, of a pale horn-colour, rather compressed round the margin; umbo central, small, but extremely prominent, giving a cordiform appearance to the lateral aspect of the shell; in each valve a primary tooth, one of which is plain, the other bifid; length three-tenths of an inch.

Test. Brit. page 89, *Cardium lacustre.*

First observed as British by Mr Swainson, in a river near Bulstrode; and since, in several places in England by Mr Montagu.

Genus XXXIV. Mactra.

XXXIV. Mactra. *Shell equivalve, inequilateral, transverse, a little gaping at the sides; the hinge tooth complicated, with an adjacent little pit; the lateral teeth remote, compressed, and inserted; ligament internal, inserted in the pit of the hinge.*

Bivalves.

Solida,

1. *Solida.* Shell strong, sub-triangular, of a yellowish-white colour, with a few concentric ridges; sides nearly equal; lateral teeth large, prominent, crenated within; length an inch and a half, breadth an inch and three quarters.

Brit. Zool. tab. 52. fig. 43.
Brit. Shells. tab. 61.

A common shell on all the coasts.

Truncata,

2. *Truncata.* Shell triangular, strong, thick, and nearly smooth; umbo central, large, and very prominent; sides equal, much flattened, and truncated; the front margin rounded; length an inch and a half, breadth an inch and three quarters.

Brit. Shells, tab. 126. M. subtruncata.

Common on all the coasts.

Subtruncata,

3. *Subtruncata.* Shell strong, sub-triangular, transversely striated, rounded on one side, the other more pointed and longer; umbo large and prominent, the sides near the beak much turned inwards, especially the anterior, which is depressed into a cordiform shape when the whole shell is viewed sidewise; length three quarters of an inch, breadth an inch.

Test. Brit. tab. 27. fig. 1.
Brit. Zool. tab. 52. fig. 42. M. stultorum.

Equally common with the preceding species.

Stultorum,

4. *Stultorum.* Shell thin, sub-triangular, semi-pellucid, faintly striated transversely, irregularly rayed longitudinally with broad and narrow whitish lines; umbo central, prominent, sides nearly equal; length an inch and three quarters, breadth two inches and a quarter.

Brit. Zool. tab. 49. fig. 30. Tellina radiata.

Common on all the British shores.

Cinerea,

5. *Cinerea.* Shell thin, sub-triangular, truncated, and of a cinereous colour; beak large and very prominent, slightly turned to one side, beneath which there is a depression; opposite side much compressed laterally; inside pale, with a tinge of blush.

Test. Brit. p. 35.

Found by Mr Bryer on the coast at Weymouth.

Dealbata,

6. *Dealbata.* Shell thin, fragile, pellucid, oval, white, very finely striated, with a few coarser concentric wrinkles; the smaller end gaping a little; umbo nearest the larger end; middle tooth in one valve broad, bifurcated, angulated close to the beak; lateral teeth not very remote; inside glossy white, moderately concave; margin plain, with a sharp edge; length an inch, breadth an inch and a half.

Test. Brit. tab. 5. fig. 1.

First noticed as British by Dr Pulteney, who received it from Mr Bryer at Weymouth.

Triangularis,

7. *Triangularis.* Shell white, opake, strong, sub-triangular; beak prominent, obtuse; sides a little unequal; hinge strong, primary teeth in one valve large bifid, in the other two small teeth, with a triangular cavity between; lateral teeth depressed; margin strongly crenated; length one-eighth of an inch, breadth rather less.

Test. Brit. tab. 3. fig. 5.

Found by Mr Montagu in Falmouth harbour, and on the coast of Devon.

Minutissima,

8. *Minutissima.* Shell white, nearly smooth, sub-triangular; umbo prominent; inside smooth, margin plain; hinge strong; primary teeth in one valve two, separated by a cavity for the reception of a single large tooth in the opposite valve.

Test. Brit. p. 37.

Found by Mr Montagu on a new species of coralline, in company with *Pecten fragilis.*

Glauca.

9. *Glauca.* Shell oval, of a dirty white colour, very finely striated transversely, and marked with broad and narrow glaucous rays; the anterior end wrinkled; the beaks reflect backwards, with a narrow gape between them; length two inches and a half, breadth three inches and a half.

Brit. Shells, tab. 125.

Found by Miss Pocock on Hale sands, under Lelant, Cornwall.

Genus XXXV. Lutraria.

XXXV. Lutraria.

Shell transverse, inequivalved, gaping at the extremities; two oblique diverging hinge teeth accompany a large pit for the reception of the ligament; no lateral teeth.

Vulgaris,

1. *Vulgaris.* Shell oblong-oval, gaping a little at both ends, yellowish-white, with irregular concentric striæ; umbo small, placed near to one side, from which the shell slopes a little; tooth in one valve triangular; length two inches and a half, breadth five inches.

Brit. Shells, tab. 58. Mactra lutraria.

Common on many parts of the coast, especially at the influx of rivers.

Hians,

2. *Hians.* Shell strong, rugose, oblong, with concentric wrinkles; umbo small, margin next to the hinge sub-arcuated; inside white, with a strong elevated ridge along the upper side of the cicatrix; the longer end with a considerable gape; length two inches and a quarter, breadth five inches.

Brit. Shells, tab. 140. *Mactra hians.*

Frequent on the English coast.

Genus XXXVI. Donax.

XXXVI. Donax.

Shell equivalved, inequilateral, anterior margin obtuse; the hinge teeth two, either in one or both valves; the lateral teeth one or two, rather distant.

Trunculus,

1. *Trunculus.* Shell oblong, smooth, glossy, finely striated longitudinally, covered with a thin epidermis; umbo small, placed nearest to the lesser end; margin crenated; length five-eighths of an inch, breadth an inch and a half.

Brit. Zool. tab. 55. fig. 45.
Brit. Shells, tab. 29. fig. 1.

On most of the sandy British shores.

Denticulata,

2. *Denticulata.* Shell strong, thick, sub-cuneiform, striated longitudinally; the interstices punctated; large end much sloped and truncated, with a prominent ridge upon the angle of the slope; hinge with strong teeth; margin denticulated; length about six-eighths of an inch, breadth an inch.

Brit. Zool. tab. 55. fig. 46.
Brit. Shells, tab. 24. D. crenulata.

A rare British species, said to be found by Dr Pulteney and by Mr Breyer at Weymouth.

Complanata,

3. *Complanata.* Shell oblong, smooth, and glossy, of a light yellow or faint purplish colour, with spots or streaks of white, and one broad ray from the beak to the margin; umbo placed nearest to one end; teeth small, margin plain; length five-eighths of an inch, breadth an inch and a quarter.

Test. Brit. tab. 5. fig. 4.

Found by Mr Montagu on the coast of Devon. It likewise inhabits the Cornwall and Dorset coasts.

Plebeia,

4. *Plebeia.* Shell thick, strong, oblong, sub-oval, of a dull horn colour, smooth and glossy, generally marked with two brown stripes longitudinally from the beak, which is placed nearest to one side; margin plain; length about half an inch, breadth three quarters.

Test. Brit. tab. 5. fig. 2.

First found at Weymouth by the Duchess of Portland, and since at the same place by Mr Bryer. Also at Dunbar by Mr Laskey.

Bivalves.

Irus,

5. *Irus.* Shell sub-oval, opake, rugose, with high concentric membranaceous ridges, reflecting upwards, broken or undulated; interstices finely striated; umbo small, placed near one side; apex much turned; teeth small, bifid; margin plain; length half an inch, breadth three quarters.

Brit. Shells, tab. 29. fig. 2.

Found frequently on the western coast of England burrowed in limestone.

Castanea,

6. *Castanea.* Shell strong, glossy, chesnut-coloured, furnished with a few irregular transverse wrinkles; a ray of chesnut runs from the beak to the opposite margin, in a curved direction; beak obtuse, inclining to the anterior side; one large and one small tooth in each valve; no lateral teeth; margin plain; length a quarter of an inch, breadth three-eighths.

Test. Brit. tab. 17. fig. 2.

Discovered by Mr Montagu in St Austle's bay, Cornwall; and found by Mr Laskey at Dunbar.

Rubra,

7. *Rubra.* Shell smooth, of a reddish colour, cuneiform, truncated at one end; beak obtuse; inside of the same colour; margin plain; hinge with two teeth in each valve, placed angularly, and approximating at the beak; very minute, not a line in length.

Test. Brit. Sup. p. 38.

Discovered by Mr Montagu among *Corallines*, in deep water.

XXXVII. Venus.

Genus XXXVII. Venus.

Shell equivalve, the frontal margin flattened with incumbent lips; hinge with three approximate and diverging teeth.

Paphia,

1. *Paphia.* Shell strong, flattened, sub-orbicular, with several elevated broad concentric ridges variously coloured; beak central, much turned to one side, beneath which is a cordiform depression; hinge with strong teeth; margin crenulated; length and breadth about an inch.

Brit. Shells, tab. 170.

Found on the British shores from Cornwall to Zetland.

Verrucosa,

2. *Verrucosa.* Shell strong, thick, heavy, sub-orbicular, convex, with numerous strong elevated ridges, somewhat recurved and broken at the ends; umbo turned much to one side, beneath which is a cordiform depression; cartilage slope of the right valve turns inwards, slightly striated longitudinally and marked transversely with brown streaks; margin crenated; diameter about two inches and a quarter.

Brit. Shells, tab. 44.

Brit. Zool. tab. 54. fig. 48. *Venus Erycina.*

Common on many of the British shores.

Laminosa,

3. *Laminosa.* Shell ovate, with concentric thin laminal ridges, very little reflected; striated in a longitudinal direction between the ridges at the umbonal region; beak pointed inclining to one side with a cordiform depression; hinge with four teeth in each valve; margin finely crenated; length about an inch, breadth an inch and a quarter.

Brit. Shells, tab. 115.

Mem. Wer. Soc. vol. i. tab. 8. fig. 16.

Found on the coast of Devonshire by Mr Montagu, and in the Frith of Forth by Mr Laskey.

Striatula,

4. *Striatula.* Shell strong sub-cordated with numerous fine prominent recurved concentric striæ; yellowish, rayed with rufous brown, and frequently marked with fine zigzag streaks of the same colour; umbo turns to one side, beneath which is a cordiform depression; cartilage slope much depressed, faintly striated; margin crenated; length an inch, breadth an inch and a quarter.

Brit. Zool. tab. 56. fig. 50.

Brit. Shells, tab. 68.

In sandy bays frequent in company with the common cockle.

Islandica,

5. *Islandica.* Shell strong, thick, sub-orbicular, convex, white, with a dark brown epidermis; wrought with fine irregular concentric striæ; beak pointed, turned inwards, and curved to one side; no depression; margin plain; length three inches and three quarters; breadth four inches and a quarter.

Brit. Zool. tab. 53. fig. 47. *V. mercenaria.*

Brit. Shells, tab. 77.

Common on the British shores. From the Frith of Forth, we have seen one which was 13 inches in circumference, and weighed nine ounces and a half. At St Andrews' they are called *Dakies*, and in Zetland *Cuvies*.

Chione,

6. *Chione.* Shell strong, sub-cordated, wrinkled concentrically, covered with a very smooth glossy chesnut coloured epidermis more or less radiated with a darker shade; umbo placed nearest to one end, with the apex turned sidewise, beneath which is a strong cordiform depression; margin plain; length three inches, breadth three inches and three quarters.

Brit. Shells, tab. 17.

Not uncommon on the Cornish coast, where they are called *Queens*, more rare on the Dorset and Cheshire coasts.

Exoleta,

7. *Exoleta.* Shell strong, orbicular, with fine close-set, thread-like, concentric striæ, with a few obsolete ridges; umbo much turned to one side, beneath which is a short much depressed cordiform depression; margin plain; diameter two inches.

Brit. Zool. tab. 54. fig. 49.

Brit. Shells, tab. 42. fig. 1.

Not uncommon on the British shores.

Undata,

8. *Undata.* Shell orbicular, thin, white with fine concentric irregular striæ, which sometimes run into uneven wrinkles; umbo prominent, apex pointed and turning to one side; no depression; inside smooth, concave; margin plain; edge acute, and somewhat undulated; length an inch and a quarter, breadth an inch and a half.

Brit. Zool. tab. 55. fig. 51.

Not unfrequent on the British shores.

Tigerina,

9. *Tigerina.* Shell suborbicular, flat, lenticular, thin, white, striated longitudinally and minutely striated transversely; beak small, pointed and turning a little to one side; margin plain; diameter about three quarters of an inch.

Test. Brit. tab. 4. fig. 1.

First ascertained to be English by Dr Maton, who found it on Studland beach, Dorsetshire, on the North shore, Poole, and at Weymouth.

Sinuosa,

10. *Sinuosa.* Shell thin, convex, with a very deep obtuse sinus, or bending, on the front.

Brit. Zool. tab. 55. fig. 51. A.

Figured by Pennant from the Portland Cabinet. An uncertain species.

Ovata,

11. *Ovata.* Shell sub-oval, opake, somewhat compressed, with strong longitudinal ribs, transversely striated; umbo nearly central, apex turning a little to one side, beneath which is a subcordiform depression turning a little to one side; margin finely crenated; length three-eighths of an inch, breadth half an inch.

Brit. Zool. tab. 56. fig. 56.

Pult. Dorset. tab. 1. fig. 15.

Bivalves.

First figured by Pennant. Found in England on the British and Devonshire coasts, and at Falmouth in Cornwall. In Scotland in the Frith of Forth, Cromarty and Zetland.

Minima,

12. *Minima.* Shell sub-orbicular a little compressed, flesh coloured, and glossy with broad concentric striæ; from the beak two white lines, in shape like the letter V, run half way down the shell; umbo prominent, pointed, and a little turned to one side; inside glossy white; margin plain; length a quarter of an inch; breadth rather more.

Test. Brit. tab. 3. fig. 3.

Dredged up at Falmouth harbour by Mr Montagu.

Subcordata,

13. *Subcordata.* Shell white, cordate, with strong longitudinal costated striæ, with remote transverse ridges, making the depressions between in the shape of a long square; beak nearest one end, incurvated; anterior side almost straight and much sloping from the beak; margin subcrenated; diameter a quarter of an inch.

Test. Brit. tab. 3. fig. 1.

Found by Mr Montagu in sand from Falmouth harbour.

Granulata,

14. *Granulata.* Shell thick, sub-orbicular, strongly reticulated, of a white colour, with spots and streaks of a brown colour; umbo much turned to one side, beneath which is a cordiform depression; margin crenated; length seven-eighths of an inch, breadth one inch.

Brit. Shells, tab. 83.

Found at Cornwall; Mr Donovan. At Falmouth harbour by Mr Montagu.

Deflorata,

15. *Deflorata.* Shell oblong, sub-oval, thin, tinged with purple, with undulated longitudinal striæ and a few transverse wrinkles; beak placed a little to one side, not very pointed; hinge with two teeth in each valve; length an inch, breadth an inch and three quarters.

Brit. Zool. tab. 57. fig. 54.
Test. Brit. tab. 3. fig. 4.

First described as British by Pennant. Found at Falmouth by Mr Montagu.

Decussata,

16. *Decussata.* Shell sub-rhomboidal; strongly reticulated; cut off diagonally at the anterior end, at which part it is most strongly reticulated; umbo nearest to one end, apex turned to one side, beneath which is a slight lanceolate cordiform depression; hinge with three teeth in each valve, one of which is small, and in one valve is almost obsolete; length two inches, breadth three inches.

Brit. Zool. tab. 57. fig. 53.
Brit. Shells, tab. 67.
Lin. Trans. vol. viii. tab. 2. fig. 6.

Common on many parts of the coast.

Pullastra,

17. *Pullastra.* Shell resembles the last in shape, longitudinal striæ fine with concentric wrinkles; cicatrix broad and divided from the border; length about an inch and a quarter, breadth two inches.

Lin. Trans. vol. viii. tab. 2. fig. 7.
Lin. Trans. vol. vi. tab. 17. fig. 13, 14. (Wood.)

First separated from the preceding by Mr Wood. Common on the English and Scottish coasts. In Devonshire it is called *pullit*, and in Zetland *cullcock*.

Perforans,

18. *Perforans.* Shell sub-rhomboidal, concentrically striated; running into strong wrinkles at the anterior side; umbo near one end, and turned a little sidewise; hinge with three teeth in each valve, one of which is small, the others long slender, and curve outwards; length three eighths of an inch, breadth five eighths.

Test. Brit. tab. 3. fig. 6.

Discovered by Mr Montagu burrowed in limestone at Plymouth. It is likewise found in several places on the Scottish coast.

Virginea,

19. *Virginea.* Shell strong sub-oval, transversely striated, interrupted in a few places by a deeper furrow; umbo placed much to one side, beneath which is a lanceolate cordiform depression; hinge with three teeth in each valve, the outer ones diverging, middle ones bifid; margin plain, edge obtuse; length an inch and a half, breadth two inches.

Brit. Zool. tab. 55. fig. without number. V. rhomboides.
Lin. Trans. vol. viii. tab. ii. fig. 8.

Common on the English coasts. The specimen from which the above dimensions were taken we found in Zetland.

Aurea,

20. *Aurea.* Shell subcordated, moderately strong, rounded at both ends like the last, striated transversely, and marked with faint longitudinal striæ; umbo placed near to one end, small pointed, turned to one side, with a cordiform depression; valves concave; hinge furnished with three teeth in each valve, the middle one bifid; length commonly about an inch, breadth an inch and three eighths.

Brit. Zool. tab. 67. fig. 34, *Tellina rugosa.*
Lin. Trans. vol. viii. tab. 2. fig. 9.
Pult. *Dorset.* tab. 13. fig. 3, *V. Nebulosa.*

On the English shores frequent; found likewise by Mr Laskey in the Frith of Forth.

Sulcata,

21. *Sulcata.* Shell sub-triangular, smooth, obsolete wrinkles; umbo very prominent and large, turning a little to one side, beneath which is a lanceolate cordiform depression; cartilage slope depressed; margin crenated; hinge in one valve of three teeth, the middle one much larger than the others; length seven-eighths of an inch.

Lin. Trans. vol. viii. tab. 2. fig. 2.

From the north of Scotland. (Mr Swainson.)

Triangularis,

22. *Triangularis.* Shell strong, sub-triangular, yellowish-white, with a few obsolete concentric ridges; umbo central, prominent, and turned a little to one side; each side slopes nearly equal; a lanceolate cordiform depression; hinge in one valve furnished with two strong teeth, one running backwards parallel with the cartilage slope, bifid; margin plain; length half an inch, breadth nearly the same.

Test. Brit. tab. 17. fig. 3.

Found by Mr Montagu on the coast of Devon.

Spinifera,

23. *Spinifera.* Shell sub-triangular, with numerous concentric equidistant ridges at the anterior end, becoming confluent, and forming short obtuse reflected spires; beak central, and turned a little to one side; hinge with a single primary tooth, and a small cavity on each side receiving two teeth from the opposite valve; margins plain; length half an inch, breadth a little more.

Test. Brit. tab. 17. fig. 1.

Discovered by Mr Montagu in a heap of sand from Salcomb-bay, Devonshire.

Reflexa,

24. *Reflexa.* Shell sub-orbicular, with thin laminal reflected ridges, and fine longitudinal striæ; hinge furnished with three strong teeth in each valve, the middle one of which is sub-bifid; margin finely crenulated; diameter about an inch.

Mem. Wer. Soc. vol. i. tab. 8. fig. 1.

Discovered in the Frith of Forth by Mr Laskey. Mr Montagu has found it on the coast of Devon.

Orbiculata,

25. *Orbiculata.* Shell white, depressed, orbicular,

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cancellated; beak very small, with a minute cordiform depression; inside white; margin plain; teeth, two, primary, approximate, and one remote, standing transverse; the margin where the lateral tooth is placed projects into an angle; diameter five-eighths of an inch.

Test. Brit. tab. 29. fig. 7.

Found on the shore near Dunbar by Mr Laskey.

Dysera,

26. *Dysera.* Shell sub-ovate, sub-cordate, with distant concentric, elevated, and reflected ridges, the interstices coarsely striated in a longitudinal direction; beak small and much reclined; hinge furnished with three teeth in each valve; margin crenulated; diameter not quite three quarters of an inch.

Lister's *Conch.* tab. 277, 278.

Found in the Frith of Forth by Mr Laskey.

Compressa,

27. *Compressa.* Shell strong, thick, sub-orbicular, compressed, and slightly sulcated; epidermis yellowish-brown; beak prominent, turned to one side, with a small lanceolate cordiform depression; margin flat; diameter rarely an inch.

Test. Brit. tab. 26. fig. 1. 1. 1.

Found by Mr Laskey at Dunbar. We have observed it in the Murray Frith and in Zetland.

Scotica,

28. *Scotica.* Shell thick, sub-cordated, sub-compressed, with many regular, parallel, transverse ridges; epidermis brown; beak reclined; depression lanceolate; inside white, glossy; teeth strong, oblique; margin plain; length nearly three quarters of an inch, breadth nearly an inch.

Lin. Trans. vol. viii. tab. 2. fig. 3.

Found by Mr M'Leay on the coast of Caithness: we have found it in Zetland, the Murray Frith, and the island of Arran.

Danmonia,

29. *Danmonia.* Shell thick, transversely ovate, sub-compressed, and furrowed with many equidistant strong concentric ridges, which, with the intermediate sulci, are quite smooth; epidermis brown; beak nearly central and somewhat reclined; cartilage slope linear; depression cordiform; margin crenulated; length an inch, breadth an inch and a quarter.

Test. Brit. tab. 29. fig. 4.

Found by Mr Montagu in deep water off the coast of Devon, and by Mr Laskey in the Frith of Forth. Nearly allied to the preceding species.

Lactea,

30. *Lactea.* Shell thick, heavy, lentiform, somewhat compressed, with thick, elevated, obtuse concentric striæ, and slightly truncated anteriorly.

Brit. Shells, tab. 149.

On the western coast of England, (Mr Donovan,) and on Tyningham sands, near Dunbar, by Mr Laskey.

Cassina,

31. *Cassina.* Shell thick, with brown lines, furnished with numerous transverse, recurved, acute laminæ; the posterior margin crenulated and grooved behind the beak; umbo reddish; depression brown; diameter an inch and a half.

Lin. Trans. vol. viii. tab. 2. fig. 1.

Found by Mr M'Leay on the coast of Caithness, and by Mr Neill in Orkney.

Guincensis,

32. *Guincensis.* Shell sub-cordate, with numerous close regular sharp ridges; colour cinereous, with two or three rays of purplish-brown running from the umbo; the cordiform and cartilage depression purple; margin plain; length an inch and a quarter, breadth one inch and a half.

Test. Brit. page 48. *Sup.*

Found by Mr Laskey off St Abb's Head, and by Mr Bryer at Weymouth.

Substriata,

33. *Substriata.* Shell transversely ovate, sub-pellucid, white, concentrically wrinkled, and obsoletely wrought with undulated longitudinal striæ; beak near one end small, turning towards the shortest side; margin plain; length half an inch.

Test. Brit. tab. 29. fig. 6.

Found by Mr Laskey off the isle of May in the Forth.

Subrhomboidea.

34. *Subrhomboidea.* Shell sub-rhomboidal, rounded at one end, and truncated at the other, and irregularly wrinkled concentrically, especially towards the margin, where the ridges are prominent but obtuse; margin plain behind the teeth, projecting inwards; length half an inch, breadth three quarters.

Test. Brit. tab. 28. fig. 2.

Found by the same gentleman with the preceding species.

Genus XXXVIII. Isocardia.

XXXVIII. Isocardia.

Shell heartshaped, with separated, involuted, and diverging beaks; the hinge formed by two flattened cardinal inserted teeth, and an isolated lateral tooth under the cartilage slope.

Cor.

1. *Cor.* Shell sub-globose, thick, strong, nearly smooth, or slightly wrinkled transversely, covered with a yellowish-brown epidermis; beaks large, prominent, incurvated, not touching when the valves are closed; hinge strong; teeth flattish; inside smooth, white; margin plain; diameter three inches.

Brit. Shells, tab. 134. *Chama Cor.*

Mem. Wer. Soc. vol. i. tab. 8. fig. 7.

Found near the North Foreland by Mr Swainson, on the shores of the Hebrides by Mr Agnew, and alive off St Abb's Head by Mr Laskey.

Genus XXXIX. Terebratula.

XXXIX. Terebratula.

Shell convex, equilateral, inequivalved, the largest valve produced into an incumbent beak, pierced with a hole, through which a ligament passes by which the shell is affixed; hinge with two cardinal teeth.

Vitrea.

1. *Vitrea.* Shell ventricose, hyaline; front margin a little truncated, concentrically striated or wrinkled, and minutely punctured all over; lower valve with two lateral teeth, from which proceed two horizontal bony spicula with a small tooth towards the base of each, running three-fourths across the shell; upper valve with two lateral bifid teeth, with the beak perforated; length an inch and a tenth, breadth two tenths less.

Found in a fishing boat in Zetland; taken in deep water.

Genus XL. Nucula.

XL. Nucula.

Shell inequilateral, equivalved, sub-triangular, hinge on a bent line, with numerous transverse parallel teeth, and a cardinal tooth in each valve at the angle, not inserted, beaks approximating and turned backwards.

Obs. The genus Arca of Linnæus has been divided into three genera by Lamarck, which, in our opinion, are perfectly distinct and well characterised. The angular hinge of the Nucula, the straight hinge of the Arca, and the arched hinge of the Pectunculus, are marks of distinction too striking and obvious to admit of their union under one genus. They might form a very good section of the dentated divison of bivalves.

Nuclea.

1. *Nuclea.* Shell sub-triangular white, with an olivaceous epidermis, concentrically wrinkled and crossed with numerous minute stria; umbo placed a little to one side, beneath which is a cordiform depression; inside glossy silvery white; hinge angular, beset with

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numerous fine regular pectinated teeth; margin finely crenated; length three-eighths of an inch; breadth somewhat more.

Brit. Shells, tab. 63. Arca nucleus.

Found on the British shores from Zetland to Cornwall.

Minuta, 2. *Minuta.* Shell somewhat oblong, the anterior side running into an angulated beak cut off at the point; finely striated transversely interrupted by three or four strong concentric ridges; umbo very small, beneath, which is a smooth depression; teeth numerous, angulated; a cavity under the apex destitute of teeth; margin plain; length three-eighths of an inch; breadth about half an inch.

Brit. Shells, tab. 78. Arca caudata.

Found by Mr Boys at Sandwich, and at Dunbar by Mr Laskey; it likewise occurs in Zetland.

Rostrata, 3. *Rostrata.* Shell sub-ovate, the smaller end produced into a lip, which is reflected or arcuated, the opposite end rounded; beak small, nearly central, a little reclined; pellucid, horn-coloured, glossy, wrought with very fine regularly transverse striæ; margin plain; length half an inch; breadth three quarters.

Test. Brit. tab. 27. fig. 7.

Found by Mr Laskey in the Frith of Forth.

Tenuis. 4. *Tenuis.* Shell sub-cordate, smooth, white, covered with an olivaceous epidermis; umbo very small; beaks slightly inflected and placed near one end; inside smooth, white, and somewhat nacred; margin thin and entire, hinge pectinated with about fifteen elevated teeth, six on one side and nine on the other, divided by a small concave plate that projects inwards; diameter about a quarter of an inch.

Genus XLI. Arca.

XLI. Arca. *Shell transverse, inequilateral, beaks distant; hinge in a straight line, plain at the ends, and furnished with a row of transverse parallel mutually inserted teeth; ligament exterior.*

Lactea, 1. *Lactea.* Shell rhomboidal, yellowish white, covered with a brown pilous epidermis, under which it is furnished with numerous fine close-set rib-like longitudinal striæ, with a few concentric wrinkles, giving the shell a reticulated appearance; umbo turned to one side; margin crenulated.

Brit. Zool. tab. 58. fig. 59.
Brit. Shells, tab. 135.

On the shores of England and Scotland; not common.

Noæ, 2. *Noæ.* Shell sub-rhomboidal, the smaller end of each valve turning inwards, forming a sharp angle, giving the smaller end of the shell a sub-cordated appearance; umbo placed nearest to one side; apex prominent, shell striated, reticulated; colour rufous brown, inside whitish, or tinged with brown; breadth about half an inch.

Test. Brit. tab. 4. fig. 3. 3.

Found on the British shores, but not frequent.

Fusca, 3. *Fusca.* Shell finely reticulated, of a purplish brown colour, destitute of any markings.

Brit. Shells, tab. 158. fig. 34.

Found on the shores of Cornwall by Mr Donovan, in Devonshire by Mr Montagu, and at Dunbar by Mr Laskey.

Genus XLII. Pectunculus.

XLII. Pectunculus. *Shell orbicular, sub-equilateral, hinge arched, and furnished with a row of oblique, mutually inserted teeth; ligament external.*

Pilosus, 1. *Pilosus.* Shell strong, orbicular, covered with a dark brown pilous epidermis, particularly about the margin; beneath this the shell is coloured with zig-zag lines of chesnut; faintly striated longitudinally, and obsoletely wrinkled transversely; inside white, margin crenated; diameter two inches and a half or more.

Brit. Zool. tab. 58, fig. 68. Arca glycymeris.
Brit. Shells, tab. 37.
Lin. Trans. vol. viii. tab. 3. fig. 3. 4.

Common to Cornwall and Zetland. In Orkney we have observed vast quantities of them thrown ashore, of a very large size.

DIVISION II. TOOTHLESS.

In this division a simple ligament connects the valves, and the hinge is destitute of teeth which lock into one another. It admits of a division into two Sections.

SECTION I. INEQUIVALVE.

The inequivalve shells are in general somewhat irregular in their growth, and have one of the valves larger and more convex than the other.

Genus XLIII. Pecten.

XLIII. Pecten. *Shell eared; beaks contiguous; hinge without teeth; ligament internal, fixed to a triangular cardinal cavity.*

Maximus, 1. *Maximus.* Shell with fourteen or fifteen ribs, longitudinally grooved, and wrought with very fine striæ; upper valve flat, with a depression at the umbo; lower valve convex; auricles striated, equal, rectangular; length five inches, breadth six.

Brit. Zool. tab. 59. fig. 61.
Brit. Shells, tab. 49.

Found on various parts of the British shores.

Jacobæus, 2. *Jacobæus.* Shell with seventeen or eighteen very convex ribs, rounded and striated transversely; a smooth whitish depression at the umbo; lower valve pure white; auricles equal, rectangular, striated; length four inches, breadth five.

Brit. Zool. tab. 60. fig. 62.

First noticed as British by Pennant; found in Dorset, Cornwall, and Yorkshire.

Opercularis, 3. *Opercularis.* Shell sub-orbicular, with about twenty round transversely striated ribs; colour reddish; auricles nearly similar; diameter about two inches and a half.

Brit. Shells, tab. 12. Ostrea subrufus.
Brit. Zool. tab. 60. fig. 63. P. subrufus.

Common on the British shores.

Varius, 4. *Varius.* Shell with twenty-eight echinated ribs; colour various, clouded; upper valve less convex than the other; auricles very unequal; the longest ear on the superior valve much wrinkled, the other striated sidewise; beneath the long ear of the superior valve, a few teeth like laminæ; length two inches and a quarter.

Brit. Zool. tab. 61. fig. 64.
Brit. Shells, tab. 1. fig. 1.

On the English shores frequent; found in Orkney by Mr Neil, and in the Frith of Forth by Mr Sime.

Lineatus, 5. *Lineatus.* Shell sub-orbicular, with eighteen narrow ribs with a red line upon the ridge of each on the upper valve; lower valve white; auricles nearly

Bivalves. equal; length an inch and a half, breadth not quite so much.

Brit. Shells, tab. 116.

Found on several places on the English coast.

Distortus, 6. *Distortus.* Shell distorted, with numerous rib-like striæ; upper valve flattened, the under valve irregular; young shells with concave short spines on the ribs; length two inches, breadth two inches and a half.

Brit. Zool. tab. 61. fig. 65.

Brit. Shells, tab. 34.

Wallace's *Orkney*, p. 44. tab. 1.

Found on several places on the English coast; it likewise occurs in Orkney and Zetland.

Obsoletus, 7. *Obsoletus.* Shell with numerous fine longitudinal striæ; eight or ten of these more prominent than others, at irregular distances; sometimes smooth; valves equal, rather flat; auricles unequal, one very large, striated, the other extremely small; white shell, with minute decussating striæ, giving the shell a shagreen appearance.

Lin. Trans. vol. viii. tab. 3. fig. 5.

On the English and Scottish shores frequent.

Glaber, 8. *Glaber.* Shell with seven rounded rays, not much elevated, with longitudinal striæ; and ears nearly equal and large, one of them reticulated, the other striated; inside marked with twenty-one slender rays, middle ones in fours; length three quarters of an inch.

Test. Brit. tab. 28, fig. 6.

Found in Anglesea by Mr Pennant, and on the Scottish coast.

Lævis, 9. *Lævis.* Shell smooth glossy, slightly wrinkled concentrically; colour whitish; one ear very large, the other small and slightly striated longitudinally; diameter about half an inch.

Test. Brit. p 61. Sup.

Found by Mr Montagu in Falmouth harbour. Pennant marks his shell from Anglesea.

Similis, 10. *Similis.* Shell thin, semitransparent, smooth, beautifully clouded with brown, of a compressed globose form, with unequal ears.

Mem. Wer. Soc vol. i. tab. 8. fig. 8.

Found by Mr Laskey in the Frith of Forth.

Fragilis, 11. *Fragilis.* Shell subovate, oblong, convex, fragile, sub-pellucid, white, wrought with numerous slightly undulated longitudinal striæ, with two or three minutely fine intermediate ones; valves equal inequilateral, one side straight, the other arcuated; auricles equal small; hinge a little oblique; length three quarters of an inch, breadth scarcely half an inch.

Test. Brit. p. 62. Sup.

Found by Mr Montagu on the coast of Devon, intermixed with *sertulariæ*.

Subauriculata. 12. *Subauriculata.* Shell ovate, oblong, pellucid, white, equilateral, equivalve, with small equal angular projections or auricles, wrought with numerous longitudinal striæ that slightly crenate the margin; along the middle are two striæ, that appear more conspicuous than the rest, by being opake, and are equally evident on the inside; length a quarter of an inch, breadth half its length.

Test. Brit. tab. 29. fig. 2.

Found by Mr Montagu with the preceding species, and we have found it in Zetland.

Genus XLIV. Ostrea.

XLIV. Ostrea. *Shell adhering, inequivalve; hinge toothless, with a cardinal oblong transversely striated cavity, to which the ligament is attached; one muscular impression in each valve*

Bivalves. Edulis. 1. *Edulis.* Shell sub-orbicular, rugged, with imbricated membranaceous folds.

Brit. Zool. tab. 62. fig. 70. inf.

The common oyster. Found on many of the British shores. A variety occurs in Salcomb Bay, Devonshire, very thin, with membranaceous plates wrinkled into irregular interrupted ribs; upper valve flat, or rather concave on the top, with a corneus margin, half an inch broad. It is called by the fishermen *Rock Oyster.*

Genus XLV. Anomia.

Shell irregular, one valve flattened, with a perforation near the hinge, through which the animal is immoveably fixed by a testaceous operculum to some other body; hinge a transverse linear prominence on the flat valve, connected under the beak of the opposite valve by a strong cartilage. XLV. Anomia.

1. *Ephippium.* Shell sub-orbicular, irregularly wrinkled, waved, and sinuous; one valve convex, the other flat and perforated, adhering to oysters and other bodies, and taking the impression of their form; inside pearlaceous, glossed with green; diameter sometimes three inches and a half. Ephippium,

Brit Zool. tab. 62. sup. fig.

Brit. Shells, tab. 26.

Test. Min. Rar. tab. 3. fig. 20. young.

This shell is common, adhering to marine bodies. In its young state, it is more thin and membranaceous, and has been termed *A. squamula.*

2. *Aculeata.* Shell thin, compressed, muricated, with interrupted longitudinal striæ, furnished with small concave spines; beak small, turning a little downwards; under valve flat, generally plain, sometimes a little echinated towards the margin, and perforated near the hinge; length nearly half an inch. Aculeata,

Test. Brit. tab. 4. fig. 5.

Common on the roots of *algæ*, from the Zetland Islands to Cornwall.

3. *Undulata.* Shell sub-orbicular, marked with fine, irregular, undulated, longitudinal, rib-like striæ; beak very small, placed near the top, a little surrounded by the margin; under valve flat, perforated; diameter an inch and a half. Undulata,

Brit. Shells, tab. 45. *Ostrea striata.*

Common in the same situations as the *A. ephippium.*

4. *Cymbiformis.* Shell sub-ovate, lengthened, subpellucid, white; the upper valve considerably convex, contracting at the umbo, with a beak incurved upon the other valve; slightly wrinkled transversely; lower valve conforms to the shape of the body, to which it is attached; length about three-tenths, breadth two-tenths. Cymbiformis.

Lin. Trans. vol. viii. tab. 4. fig. 6.

Found by Mr M'Leay on the coast of Caithness. Mr Montagu has found it in Devonshire; and Mr Laskey in the Frith of Forth. We have observed it on the spines of Echinus Cidaris from the coast of Zetland.

A shell occurs frequently at Newhaven, near Edinburgh, in the oyster boats, which we suspect will constitute a new species of this genus, which may be termed *fusca.* Only the convex valves have occurred. These are nearly orbicular, moderately convex, closely covered with small tubercles, or plain, with a few transverse waved lines; opake, of a light brown colour, and glossy within; diameter four-tenths.

SECT. II. EQUIVALVE.

The shells of this Section are more regular in their

Bivalves. shape and form than those of the preceding. The British species divide themselves into two genera, Mytilus and Pinna.

Genus XLVII. Mytilus.

XLVII. Mytilus. *Shell with a hinge marked by a longitudinal furrow; beak towards the shortest end; usually affixed by means of a byssus.*

Edulis, 1. *Edulis.* Shell oblong, somewhat pointed at the beak, sides sloped; anterior side a little angulated; posterior side rather indented; inside blue about the margin, whitish in the middle; teeth like crenulations beneath the beak; length three inches, breadth an inch and a half.

Brit. Shells, tab. 128. fig. 1. 1.
Brit. Zool. tab. 63. fig. 73.

Found in vast beds, fixed by the byssus. The common Mussel.

Ungulatus, 2. *Ungulatus.* Shell smooth, somewhat curved; posterior margin inflected, hinge terminal, bidentated; length four or five inches.

Brit. Shells, tab. 128. fig. 2. 2.

Found on the coast of Cornwall by Miss Pocock, and on Gullon Links, near Haddington.

Incurvatus, 3. *Incurvatus.* Shell resembling *M. edulis,* but broader in proportion to its length; posterior side much incurvated; length an inch and a half, breadth an inch.

Brit. Zool. tab. 64. fig. 74.

Inhabits crevices of rocks on the shore, and the roots of *algæ.* We have taken half a dozen of specimens from the root of one fucus, all of them similar in form, though differing in size. This occurrence supports the opinion, that it is distinct from *M. edulis.*

Pellucidus, 4. *Pellucidus.* Shell thin, pellucid, of a whitish colour, tinged with blue, more or less radiated with deep blue, covered with a yellow epidermis; crenulations beneath the beak small; length about two inches, breadth one inch.

Brit. Zool. tab. 63. fig. 75.
Brit. Shells, tab. 81.

Frequent on the British shores.

Modiolus, 5. *Modiolus.* Shell oblong, sub-oval; posterior side towards the beak extends outwards a little; umbo large and prominent; length six inches, breadth three inches.

Brit. Zool. tab. 66. fig. 77.
Brit. Shells, tab. 23.

A variety occurs with a deep depression under the beak, and which has been termed *M. umbilicatus.* The young of the shell is known by the name of *M. barbatus.* Like the common Mussel, this species is abundant, and is gregarious. It is considered as an excellent bait for the haddock. In Zetland it is called Yogue.

Rugosus, 6. *Rugosus.* Shell oblong, sub-oval, with rugged concentric wrinkles; side next the hinge always rounded, the opposite side sometimes truncated; umbo small, placed near to one end; it usually gapes at one end, and opposite to the hinge; length an inch and a quarter, breadth about half its length.

Brit. Zool. tab. 63. fig. 72.
Brit. Shells, tab. 141.

Found burrowed in limestone, and in the roots of fuci.

Precisus, 7. *Precisus.* Shell oblong, irregular, rugose; hinge close to one end of the shell, which is truncated; beak large and prominent, projecting more in one valve than in the other; length a quarter of an inch, breadth half an inch.

Test. Brit. tab. 4. fig. 2.

Not uncommon among the roots of fuci.

Crista-galli. 8. *Crista-galli.* Shell rude, rugged, compressed, varying much in shape, colour, opake, ferruginous; margin scolloped, or cut into deep irregular notches in both valves, corresponding and mutually inserted; diameter two inches and a half.

Chimn. Conch. tab. 75. fig. 683.

Mr Montagu states, that it is found adhering to the bottoms of ships.

Discors, 9. *Discors.* Shell convex, sub-cordated, pellucid; the posterior and anterior sides ribbed; the middle area plain, or faintly wrinkled transversely; umbo large, prominent, apex much turned to one side; margin crenated on the part where striated; length three eighths, breadth half an inch.

Brit. Shells, tab. 25.

Frequent on the English coast, adhering to the *Ascidia mentula.* In Scotland, where it is common, it is principally found among the roots of *Fucus digitatus* and *Polyscides.*

Discrepans, 10. *Discrepans.* Shell sub-oval, compressed, pellucid, covered with a black epidermis; both sides rounded, the anterior one largest, divided into three compartments, like the preceding species; sometimes an inch and a half in breadth.

Test. Brit. tab. 26. fig. 4.

Found in Wales and Devonshire by Mr Montagu. Not uncommon in the Frith of Forth.

Cygneus, 11. *Cygneus.* Shell thin, fragile, semi-pellucid, oval, wrinkled concentrically, and covered with an olivaceous green epidermis; umbo very small, placed nearest one end; inside glossy, pearlaceous; length two inches and a half, breadth nearly six inches.

Brit. Zool. tab. 67. fig. 78.
Brit. Shells, tab. 55.

Found in England in ponds and stagnant waters.

Anatinus, 12. *Anatinus.* Shell thin, semi-pellucid, oval, of a greener colour than the last, less convex, and the margin at the hinge more prominent, rising into a sort of angulated wing; length two inches, breadth three inches and a half.

Brit. Zool. tab. 68. fig. 79.
Brit. Shells, tab. 113.

Frequent in rivers in England and Scotland.

Avonensis, 13. *Avonensis.* Shell suboval, olivaceous, with concentric wrinkles; size of the preceding, but broader in proportion to its length, and not so much produced at the hinge; posterior side more obtuse; front margin nearly straight, or frequently subarcuated.

Lin. Trans. vol. viii. tab. 3. A. fig. 4.

Found by Mr Montagu in the River Avon, about Lackham in Wiltshire.

Plicatus, 14. *Plicatus.* Shell oblong, truncated on one side, close to the umbo; thin, pellucid, uneven, slightly plicated, beaks small, incurvated, and placed at one end, the opposite end broadest; inside glossy; length half an inch, breadth one inch.

Chimn. Conch. tab. 82. fig. 733. a. b.

Found alive off the Isle of Sky by Mr Laskey.

Decussatus, 15. *Decussatus.* Shell longitudinally ovate, sides equal, finely striated longitudinally, crossed by more minute striæ in a transverse direction, giving it a decussated appearance, when examined under a microscope; inside smooth, nacred; near the front margin a reflected transverse ridge; length one eighth of an inch, breadth not so much.

Test. Brit. p. 69. Sup.

Found by Mr Laskey in sand near Dunbar.

Bivalves.

XLVII. PINNA.

GENUS XLVII. PINNA.

Shell longitudinal, cuneiform, with an acute base; valve gaping in the upper part; hinge without teeth, extending nearly the whole length of the shell; affixed by a byssus.

Pectinata, 1. *Pectinata.* Shell pellucid, thin, brittle, marked with about eleven longitudinal striæ or ribs from the apex to the opposite margin, furnished with concave spines; about one-third of the shell opposite the hinge without ribs; breadth three inches at the gaping end, length six inches and a half, tapering to the apex.

Brit. Shells, tab. 10. *P. muricata.*

Found on the English coast, but not common.

Ingens, 2. *Ingens.* Shell rugged, with irregular concentric wrinkles running lengthwise from the beak to the open side, sometimes breaking into laminæ; hinge straight, turning a little inwards at the apex; on the under side, opposite the beak, concave; length about a foot, breadth seven inches.

Brit. Shells, tab. 152.

Found in Shetland, where they are frequently fished up on the hook by the cod-fihers. Mr Montagu has likewise found them in Salcomb bay, Devonshire.

3. *Muricata.* Shell thin, brittle, semi-pellucid, flesh-coloured, darkest at the smaller end, with ten or twelve broad ribs running longitudinally the whole length, and a few intermediate smaller ones at the narrow end; beset sparingly with concave prickles towards the larger end, principally towards the extremity; length five inches, breadth three inches. Muricata.

Test. Brit. tab. 5. fig. 3.

Found near Weymouth, Dorset, by Dr Pulteney.

ORDER III. MULTIVALVES.

Multivalves.

This order of shells was proposed by Major, under the title Pluvalvia. It includes such testaceous bodies as are composed of more pieces than two. It is by no means a natural division; and hence will only be employed in an artificial system. This order admits of two divisions.

DIVISION I. DENTATED.

In this division we include two genera, which differ widely from each other in external aspect, although they have many points of resemblanee in structure and economy.

XLVIII. PHOLAS.

GENUS XLVIII. PHOLAS.

Shell transverse, composed of two principal valves, open at each end, with small accessory pieces placed on the ligament, or at the hinge; hinge recurved, united by a cartilage, beneath which is an uncurved tooth.

Dactylus, 1. *Dactylus.* Shell striated transversely, and slightly longitudinally; the interior end strongly muricated, extending into a beak and forming a large gape; teeth, one in each valve, projecting inwards, long, curved, flat; the smaller valves are four in number; length an inch and a quarter, breadth four inches.

Brit. Zool. tab. 39. fig. 10.

Brit. Shells, tab. 118.

This shell is very common on the British shores, being found in marl, clay, and wood.

Parvus, 2. *Parvus.* Shell white, rough, longitudinally and transversely striated except at the smaller end; the larger end declines into a kind of muricated beak; hinge reflected, without cells; one plate at the back connected by a membrane to the valves; teeth one in each valve, slender, curved, with a knob at the base; length half an inch, breadth one inch.

Brit. Zool. tab. 4. fig. 13.

Test. Brit. tab. 1. fig. 7, 8.

This shell was first described by Pennant. It has been found also by Mr Montagu at Salcomb on the coast of South Devon.

Crispatus, 3. *Crispatus.* Shell opake, strong, gibbous, suboval, obtuse, and open at both ends; transversely striated; half the shell reticulated, and separated from the plain side by a broad furrow down the middle, extending from the beak to the opposite margin; hinge reflected, smooth, forming a cavity at the anterior end, which is obliquely truncated to the front margin; teeth two, long, flat, curved; length about two inches, breadth three.

Brit. Zool. tab. 40. fig. 12.

Brit. Shells, tab. 62.

On the English and Scottish shores frequent.

4. *Candidus.* Shell thin, whitish, rounded at both ends, and closed at the larger end; striated transversely, and crossed by finer striæ radiating from the beak; a few of the radii at the larger end muricated; tooth in each valve slender incurvated, above which, on the margin of one valve, is an erect toothlike process; length seven-eighths of an inch, breadth two inches and a half. Candidus,

Brit. Zool. tab. 39. fig. 11.

Brit. Shells, tab. 132.

Found on the British shores, but not common.

5. *Striatus.* Shell white, conoid, the larger end strongly reticulated, the rest irregularly striated; at the front margin the lip seems to fold back, and forms a smooth surface on the reticulated part; hinge plate large and suboval; teeth long, slender, and much curved; length half an inch, breadth three quarters. Striatus.

Brit. Shells, tab. 117.

Frequent in the bottoms of ships. It is not ascertained whether it breeds in our seas.

GENUS XLIX. TEREDO.

Shell with two principal hemispheric valves, truncated and open at the end, and two small lanceolate accessory valves remote; hinge with a long incurvated tooth in each valve; tube testaceous, sub-cylindric, flexuous, in which the animal resides but to which it is not attached. XLIX. TEREDO.

Obs. This genus was placed in the order Multivalves by Adanson. It was removed by Linnæus into the order Univalves. Its title to its former situation is now placed beyond a doubt, by the interesting observations of Mr Montagu and Mr Home.

1. *Navalis.* Tube thin, brittle, flexuous, of a whitish colour, lodged in wood; valves white, each furnished with a long flat curved tooth, projecting inwards under the hinge, and a short lateral tooth at the extremity of the hinge. Navalis,

Brit. Shells, tab. 145.

Phil. Trans. part. 2. tab. 12, 13.

This shell, called by Linnæus *calamitas navium*, is found in planks and stakes which have lain in the sea. It often pierces the planks of ships, particularly in warm climates, and soon effectually destroys them.

Multivalves.

DIVISION II. TOOTHLESS.

Toothless Shells.

The shells included in this division are not furnished with teeth at the joints. The valves are either simply united, or are furnished with a connecting ligament. This division will admit of distribution into three Sections.

SECT. I. OPERCULATED.

Operculated.

This Section includes shells which are somewhat conical, and have their opening protected by a testaceous lid or operculum, composed of four plates.

Genus L. Balanus.

L. Balanus.

Shell conical, fixed by its base, and composed of six articulated valves; the opening closed by an operculum formed of four valves.

Communis, 1. *Communis.* Shell strong, rugged, with unequal compartments longitudinally costated; valves of the lid pointed, transversely striated, with a longitudinal groove on the two longest; diameter at the base sometimes an inch, height nearly three quarters.

Brit. Zool. tab. 37, fig. 4. 6.

Brit. Shells, tab. 30, fig. 1.

Common on the British shores, adhering to rocks, stones, and old shells.

Balanoides, 2. *Balanoides.* Shell with six compartments, divided by a deep longitudinal furrow; mouth large; lid obtuse; the upper valves slightly striated transversely, the others smooth; diameter about a quarter of an inch.

Brit. Shells, tab. 36, fig. 2, 3.

Common on shells and rocks.

Punctatus, 3. *Punctatus.* Shell with indistinct compartments frequently punctured over; lid of four valves, with a few striæ, the edges of the superior and inferior valves closely united at the top, and indented; diameter about a quarter of an inch.

Test. Brit. tab. 1. fig. 5.

Common on rocks and stones.

Rugosus, *Rugosus.* Shell cylindric, usually divided into six compartments, which become broad towards the top; mouth large; inside margin ridged transversely; lid composed of four rough angulated pointed valves, not striated; diameter about three quarters of an inch.

Lin. Trans. vol. viii. tab. 1, fig. 5.

Not unfrequent on the British shores.

Clavatus, 5. *Clavatus.* Shell long, clavated, slender at the base, dilated at the top, and usually cloven into six divisions; compartments six, three wide, and three narrow, wrinkled longitudinally, and faintly striated transversely; length two inches, diameter at the base three-eighths of an inch.

Ellis's *Zoophytes,* tab. 15, fig. 7, 8.

Found at Weymouth, Dr Pulteney.

Tintinnabulum, 6. *Tintinnabulum.* Shell strong, divided into six raised and six depressed compartments; the former running to a point upwards, and striated longitudinally; the latter contracting to a point downwards, and transversely striated; mouth nearly as large as the base; length an inch and a half.

Brit. Shells, tab. 148.

Pult. Dorset. tab. 1, fig. 5.

This species was first given by Da Costa, but is probably a native of warmer climates, being brought to us on the bottoms of ships.

Costatus, 7. *Costatus.* Shell somewhat conic, ribs equidistant, and diverging from the aperture; operculum sharp pointed.

Brit. Shells. tab. 30. fig. 2.

Discovered by Mr Adams on the coast of Pembroke, and first described by Mr Donovan.

8. *Conoides.* Shell conic, valves smooth, pointed at the apex; aperture very small. Conoides,

Brit. Shells, tab. 30, fig. 3.

Found by Mr Bryer of Weymouth, and first described by Mr Montagu.

9. *Striatus.* Shell compressed; compartments strongly ribbed in an oblique direction to each other, and finely striated across the ribs; margin of the base irregularly serrated; aperture oblique, closed by a lid, and so obscured, that it is scarcely discernible; diameter a quarter of an inch. Striatus,

Brit. Zool. tab. 38, fig. 7.

Brit. Shells, tab. 36, fig. 1.

Common on the British shores, adhering to shells and to the roots of algæ.

10. *Spongeosus.* Shell ovate, with six angulated wrinkled compartments, terminating in much elevated points, and furnished with numerous spines; base concentrically wrinkled, beneath which is a cup rounded at the bottom, whose margin corresponds with the circumference of the base; lid of four valves, the posterior pair long and hooked forward, the anterior pair rough, with decussated striæ; length about half an inch. Spongeosus,

Test. Brit. tab. 17. fig. 4, 5, 6.

Found by Mr Bryer of Weymouth imbedded in a particular species of sponge resembling *Spongia tubulosa.*

In a piece of the same species of sponge from the coast of Devon, Mr Montagu found another species allied to the preceding. It was mutilated, but enough remained to point out some of its peculiar characters. The cup or base was in the form of an inverted cone, perforated at the smaller end, thick, margin of the cup bevelled off to an edge, which is striated; inside furnished with annular ridges, and lined with a membrane; outside rough, with tubercles and broad projecting plates.

In our opinion, the *Balanus spongeosus* ought to form a new genus, as it differs in character and economy from all the other species of the genus Balanus.

Genus LI. Coronula.

Shell regular, sub-rotund, sub-conical, divided into twelve areæ, with an opening both in the inferior and superior part; superior opening closed by a four-valved lid.

Obs. The shells of this genus, together with their inhabitants, are found imbedded in the fat of the whale, so as to leave only the superior aperture uncovered.

1. *Diadema.* Shell with six depressed, flat, transversely striated compartments, and six prominent ones, with elevated longitudinal ridges open at top; cavity funnel shaped, hexagonal; height an inch, diameter at the base about three inches. Diadema.

Brit. Shells, tab. 56. fig. 1. 2, *Lepas Diadema.*

Found in whales, which occasionally visit the British shores.

SECT. II. PEDUNCULATED.

The shells of this Section are furnished at their base with a cartilaginous flexible tube, by which they are immoveably fixed. These tubes are capable of being

Multivalves.

elongated or contracted at the will of the animal. The section contains at present only one genus.

LII. Lepas.

Genus LII. Lepas.

Shell wedge-shaped, composed of several unequal valves, five or more, united at the base to a cartilaginous tube.

A. Shell composed of five pieces.

Anatifera, 1. *Anatifera.* Shell compressed, the two lower valves large and subtriangular, longitudinally wrinkled and obsoletely striated in a radiated manner from the lower anterior angle; the two superior valves long and tapering downwards to an obtuse point; the upper part angulated on each side, top rounded; dorsal valve long, slender, and rounded; length an inch and a half; pedicle and connecting ligaments reddish.

Brit. Zool. tab. 39. fig. 9.
Brit. Shells, tab. 7.

Found adhering to floating wood. This was the shell which, in the ages of superstition and ignorance, was supposed to produce the Bernacle goose.

Anserifera, 2. *Anserifera.* Shell compressed, tumid at the base, larger valves striated from the lower anterior margin; the smaller valves striated from the upper posterior margin; dorsal valve compressed, slender, and brought to a fine carinated edge; length an inch.

Brit. Shells, tab. 166. fig. 2.

Found adhering to floating wood.

Sulcata, 3. *Sulcata.* Shell compressed sub-triangular; inferior valves wrought with fifteen strong diverging ribs from the lower anterior angle; the front rib forms a margin; the two superior valves form a pointed apex, become narrow downwards to a point, and are furnished with seven or eight ribs, with smaller intermediate ones; dorsal valve compressed, strongly striated longitudinally, with a smooth subcarinated edge; length about a quarter of an inch.

Test. Brit. tab. 1. fig. 6.

Found by Mr Montagu on the Dorset coast, adhering to Gorgonia flabellum.

Fascicularis, 4. *Fascicularis.* Shell bluish-white, glossy; large valves obtusely triangular, concentrically wrinkled, and divergingly striated from the exterior angle at the base, which is dilated; upper valves wrinkled parallel with the inner margin; dorsal valve narrow at the top, increasing to about two-thirds of its length, where it is bent suddenly inwards at the base, which is dilated; apex reflected; connecting ligaments transparent; peduncle short, thin, pellucid, smooth, and of a dusky colour when the animal is alive.

Ellis's *Zoophytes,* tab. 15. fig. 6.

First described by Ellis; afterwards found by Mr Bryer at Weymouth, and by Mr Montagu on the coast of Devon. We have found it in Zetland. It is usually found in clusters, attached to a white gelatinous spherical substance, which surrounds the stalks of Fuci, and even dead feathers and floating wood. The Lepas dilata of *Brit. Shells,* tab. 164, is essentially distinct from the shell we are now speaking of, although it has been hastily concluded to be the same.

Membranacea, 5. *Membranacea.* Shell with the valves connected by broad membranes, and furnished with a short peduncle; superior valves linear, projecting, and bent downwards; inferior valves narrow, and bent backwards; dorsal valve slender, about one-third of the length of the shell; length about half an inch.

Test. Brit. page 164. *Sup.*

Said to have been found on the Welch coast.

B. Valves Numerous.

Scalpellum, 6. *Scalpellum.* Shell with thirteen valves of a light brown colour, a little rough, without striæ, faintly wrinkled in some parts, and covered with short hairs; peduncle large, cylindric, annulated; length five eighths of an inch.

Test. Brit. tab. 1. fig. 3.
Brit. Shells, tab. 166. fig. 1.

First observed as British by Mr Boys of Sandwich; and afterwards by Mr Montagu from Plymouth.

Polliceps. 7. *Polliceps.* Shell of numerous valves, five of which are larger than the rest; smooth and glossy; anterior valve on each side ovate and convex; dorsal valve subovate, thick, convex, and rounded; peduncle long, with imbricated scales; length about two inches including the footstalk.

Test. Brit. tab. 28. fig. 5.

Found by Mr Laskey on the shores of Iona.

SECT. III. IMBRICATED.

Imbricated. The imbricated shells are all included in one genus. They bear a near resemblance to one another in form and habit.

Genus LIII. Chiton.

LIII. Chiton.

Shell oblong, elliptical, convex, constructed of many plates placed transversely on the back of the animal, and lying upon one another at the anterior edge.

Marginatus, 1. *Marginatus.* Shell oblong-ovate, dusky, with eight valves projecting over each other in a point or beak, at the dorsal elevation; valves like shagreen; border rough, with a ciliated edge; length five eighths of an inch, breadth three eighths.

Lin. Trans. vol. viii. tab. 1. fig. 2.

Frequent upon stones covered with sea-weed about low water. One variety occurs with seven valves, and we have found another with only six valves.

Lævis, 2. *Lævis.* Shell oblong, reddish, marbled, with eight valves, elevated in the middle and minutely shagreened; the middle valves divided on each side into two compartments from the anterior base to the beak, the anterior division striated transversely, the posterior division striated longitudinally; border broad, striated transversely and diagonally, resembling fine hair-cloth; length rarely half an inch, breadth about a quarter.

Brit. Zool. tab. 36. fig. 3.

This is a rare shell. It was first noticed by Pennant at Loch Broom in Ross-shire; Mr Montagu afterwards found it in Salcomb-bay, Devonshire; Mr Laskey met with it at Dunbar, and we have taken it in Zetland. It inhabits deeper water than the preceding species.

Ruber, 3. *Ruber.* Shell oblong, elevated on the back, reddish, variegated, with eight valves, divided on each side, from the anterior margin to the beak, into two compartments, the anterior transversely striated, the striæ bending and crossing the posterior compartment; spaces between the stria broad; border rough; size of the last.

Lin. Syst. Nat. 1107. 7.

Common in Scotland on rocks at low water.

Cinereus. 4. *Cinereus.* Shell oblong, ovate, rounded on the back; greyish, with dusky stripes; valves eight, narrow; anterior compartment striated longitudinally, the posterior diagonally; the striæ are rough, so that the shell is shagreened; border narrow, rough; length nearly half an inch, breadth upwards of a quarter.

Multivalves.

Lin. Trans. vol. viii. tab. 1. fig. 3.

Found with the preceding species. Not common.

Albus,

5. *Albus.* Shell oblong, white, with eight valves a little pointed at the dorsal elevation; minutely shagreened; striated longitudinally at the sides, and obsoletely transversely in the middle; anterior valve large; border finely but distinctly shagreened; length a quarter of an inch; breadth one eighth.

Lin. Trans. vol. viii. tab. 1, fig. 4.

Found by Dr Pulteney at Poole in Dorsetshire. We have taken it in Zetland, adhering to stones from deep water. The Linnæan character, *valvula prima postice emarginata*, does not occur in our specimens.

Lævigatus,

6. *Lævigatus.* Shell with eight valves, elevated on the back, oblong, reddish, with white stripes; valves regularly shagreened; anterior compartment striated transversely; border smooth, scarcely ciliated; length four tenths; breadth two tenths.

A new species found in Zetland along with Chiton albus.

Fascicularis,

7. *Fascicularis.* Shell oblong, ovate; valves eight; striated longitudinally on the back, and roughly shagreened on the sides; border rough, surrounded with tufts of white hairs, one at the junction of each valve, six on the margin at the front, and two at the posterior end, making twenty in number; length five eighths of an inch; breadth above two eighths.

Test. Brit. tab. 27. fig. 5.

Lin. Trans. vol. viii. tab. 1, fig. 1.

Found in several places in England. It occurs likewise in the Frith of Forth, and in Zetland.

Crinitus.

8. *Crinitus.* Shell with seven valves, thick set with short hairs. Length five eighths of an inch.

Brit. Zool. tab. 36, fig. 1.

Inhabits the sea near Aberdeen, according to Mr Pennant. Mr Boys is said to have found it at Sandwich. It is a species involved in much obscurity.

The Sabellæ are usually described along with shells in systems of Conchology. They possess cases which are composed of sand or small shells agglutinated together, and hence do not resemble the true Testacea, whose shells are secreted from the body of the inhabitant. For a description of the different species of Sabellæ, see the article Mollusca.

Tabular view of the genera and species.

Having thus given a short description of the shells of Britain, we shall now exhibit a tabular view of the genera and species which have been mentioned, and conclude with a few directions to the young conchologist, for collecting and preserving shells.

ORDER I. UNIVALVES.

DIVISION I. UNILOCULAR.

SECT. I. ASTULIDIA.

Family I. EXPANDED.

Genus I. Patella.

A.
1. Vulgata.
2. Cœrulea.
3. Pellucida.
4. Elongata.
5. Parva.
6. Elliptica.
7. Distorta.
8. Rota.

B.
9. Intorta.
10. Lacustris.
11. Oblonga.

C.
12. Antiquata.
13. Hungarica.
14. Militaris.

D.
15. Græca.
16. Apertura.
17. Zetlandica.
18. Marginata.

E.
19. Fissura.

F.
20. Chinensis.

Genera and Species.

Gen. II. Haliotis.

1. Tuberculata.

Gen. III. Sigaretus.

1. Haliotoidea.

Family II. TUBULAR.

Gen. IV. Dentalium.

1. Entalis.
2. Dentalis.
3. Striatulum.
4. Gadus.

Gen. V. Cæcum.

1. Imperforatum.
2. Trachea.
3. Glabrum.

Gen. VI. Serpula.

1. Vermicularis.
2. Triquetra.
3. Serrulata.
4. Tubularia.

Family III. FLASK-SHAPED.

Gen. VII. Lagena.

1. Striata.
2. Globosa.
3. Lævis.
4. Marginata.
5. Retorta.
6. Perlucida.
7. Urnæ.
8. Squamosa.

Family IV. SPIRAL.

Gen. VIII. Spirorbis.

A.
1. Communis.
2. Spirilium.
3. Granulatus.
4. Carinatus.
5. Corrugatus.
6. Corneus.

B.
7. Heterostrophus.
8. Sinistrorsus.
9. Minutus.
10. Conicus.
11. Lucidus.
12. Reversus.

Gen. IX. Planorbis.

1. Corneus.
2. Complanatus.
3. Carinatus.
4. Vortex.
5. Spirorbis.
6. Contortus.
7. Albus.
8. Cristatus.
9. Fontanus.
10. Nautileus.

SECT. II. STULIDIA.

Family I. TURRETED.

Tribe I. Canaliculated.

Gen. X. Buccinum.

1. Undatum.
2. Glaciale.
3. Lapillus.
4. Reticulatum.
5. Macula.
6. Ambiguum.
7. Hepaticum.
8. Bilineatum.
9. Perdix.
10. Lineatum.
11. Cinctum.
12. Minimum.
13. Terrestre.
14. Obtusulum.
15. Breve.
16. Minutum.
17. Læve.
18. Obtusissimum.

Genera and Species.

Gen. XI. Murex.

A.
1. Erinaceus.
B.
2. Subulatus.
3. Fuscatus.
4. Reticulatus.
5. Tubercularis.
6. Adversus.
C.
7. Gracilis.
8. Accinctus.
9. Attenuatus.
10. Nebula.
11. Costatus.
12. Proximus.
13 Septangularis.
14. Turricula.
15. Rufus.
16. Gyrinus.
17. Sinuosus.
18. Antiquus.
19. Subantiquatus.
20. Carinatus.
21. Corneus.
22. Linearis.
23. Purpureus.
24. Muricatus.
25. Bamfius.
26. Minutissimus.

Gen. XII. Strombus.

1. Pes Pelecani.
2. Costatus.

Tribe II. Entire.

Gen. XIII. Turbo.

A.
1. Littoreus.
2. Tenebrosus.
3. Rudis.
4. Striatulus.
5. Jugosus.
6. Mammillatus.
B
7. Terebra.
8. Cinctus.
9. Nitidissimus.
10. Subtruncatus.
11. Truncatus.
C.
12. Clathrus.
13. Clathratulus.
14. Elegantissimus.
15. Unicus.
16. Parvus.
17. Costatus.
18. Striatus.
19. Bryereus.
20. Coniferus.
21. Denticulatus.
22. Decussatus.
23. Reticulatus.
24. Spiralis.
25. Semicostatus.
26. Strigatus.
27. Carinatulus.
28. Albulus.
29. Subelegans.
30. Subarcuatus.
31. Marginatus.
32. Indistinctus.
33. Simillimus.
D
34. Elegans.
35. Vinctus.
36. Auricularis.
37. Canalis.
38. Subumbilicatus.
39. Pallidus.
40. Quadrifasciatus.
41. Disjunctus.
42. Calcar.
E.
43. Crassior.
44. Cimex.
45. Calathiscus,
46. Ventrosus,
47. Ulvæ.
48. Pullus.
49. Punctura.
50. Ruber.
51. Vitreus.
52. Nivosus.
53. Unifasciatus.
54. Cingillus.
55. Interruptus.
56. Retiformis.
57. Fuscus.
58. Rivulus.
59. Fulgidus.
60. Scriptus.
61. Divisus.
62. Subrufus.
63. Ziczac.
64. Semistriatus.

Gen. XIV. Odostomia.

A
1. Muscorum.
2. Sexdentata.
3. Tridens.
4. Carychium.
5. Juniperi.
6. Interstincta.
7. Unidentata.
8. Plicata.
9. Sandvicensis.
10. Insculpta.
B
11. Perversa.
12. Nigricans.
13. Laminata.
14. Biplicata.
15. Labiata.
16. Vertigo.

Gen. XV. Lymnæa.

1. Stagnalis.
2. Fragilis.
3. Palustris.
4. Fossaria.
5. Putris.
6. Auricularia.
7. Succinea.
8. Lutea.
9. Detrita.
10. Vivipara.
11. Fontinalis.
12. Tentaculata.
13. Elegantissima.
14. Lubrica.
15. Obscura.
16. Subcylindrica.
17. Fasciata.
18. Lackhamensis.
19. Octona.
20. Octanfracta.
21. Polita.
22. Decussata.
23. Labiosa.
24. Subulata.
25. Petræa.

Family II. GLOBOSE.

Gen. XVI. Helix.

A.
1. Pomatia.
2. Virgata.
3. Cingenda.
4. Rufescens.
5. Cantiana.
6. Hispida.
7. Lucida.
8. Trochiformis.
9. Lacuna.
10. Spinulosa.
11. Caperata.
12. Radiata.
13. Umbilicata.
14. Lapicida.
15. Ericetorum.
16. Subcarinata.
17. Depressa.
18. Paludosa.
19. Unispiralis.
20. Resupinata.
21. Reticulata.
22. Tubulata.
23. Fasciata.
24. Nitidissima.
25. Bicolor.
26. Margarita.
27. Serpuloides.
B.
28. Aspersa.
29. Nemoralis.
30. Hortensis.
31. Arbustorum.
32. Fusca.
33. Lævigata.
34. Glutinosa.
35. Striata.
36. Variegata.

Gen. XVII. Nerita.

A.
1. Littoralis.
2. Fluviatilis.
B.
3. Glaucina.
4. Canrena.
5. Nitida.
6. Pallidula.
7. Tuberosissima.
8. Rufa.
9. Pellucida.
10. Alba.

Gen. XVIII. Trochus.

A.
1. Magus.
2. Cinerarius.
3. Umbilicatus.
4. Tumidus.
5. Terrestris.
6. Fuscus.
B.
7. Crassus.
8. Tenuis.
9. Ziziphinus.
10. Exiguus.
11. Striatus.

Family III. CONVOLUTED.

Gen. XIX. Cypræa.

1. Europæa.
2. Voluta.

Gen. XX. Voluta.

1. Tornatilis.
2. Pallida.
3. Denticulata.
4. Alba.
5. Catenata.
6. Triplicata.
7. Bidentata.
8. Hyalina.
9. Heteroclita.

Genera and Species.

Gen. XXI. Bulla.

A.
1. Lignaria.
2. Ampulla.
3. Patula.
4. Aperta.
5. Plumula.
6. Catena.
7. Emarginata.
8. Denticulata.
9. Hydatis.
10. Akera.
11. Cylindracea.
12. Umbilicata.
13. Truncata.
14. Obtusa.
15. Flexilis.

B.
16. Fontinalis.
17. Rivalis.
18. Hypnorum.

DIVISION II. MULTILOCULAR.

Gen. XXII. Nautilus.

1. Beccarii.
2. Beccarii perversus.
3. Crispus.
4. Lævigatulus.
5. Calcar.
6. Lobatulus.
7. Concameratus.
8. Depressulus.
9. Umbilicatulus.
10. Crassulus.
11. Lacustris.
12. Carinatulus.
13. Inflatus.

Gen. XXIII. Orthocera.

1. Recta.
2. Radicula.
3. Subarcuata.
4. Jugosa.
5. Costata.
6. Legumen.
7. Spinulosa.
8. Bicarinata.
9. Linearis.

Gen. XXIV. Spirolina.

1. Semilitua.
2. Subarcuatula.

Gen. XXV. Miliola.

1. Bicornis.
2. Perforata.
3. Intorta.
4. Subrotunda.
5. Oblonga.

ORDER II. BIVALVES.

DIVISION I. DENTATED.

Gen. XXVI. Mya.

A.
1. Glycymeris.
2. Pholadia.
3. Arenaria.
4. Truncata.

B.
5. Margaritifera.
6. Ovalis.
7. Pictorum.
8. Suborbicularis.
9. Bidentata.
10. Decussata.
11. Purpurea.
12. Ferruginosa.
13. Nitens.

Gen. XXVII. Ligula.

1. Prætenuis.
2. Pubescens.
3. Distorta.
4. Compressa.
5. Tenuis.
6. Boysii.
7. Prismatica.
8. Substriata.

Gen. XXVIII. Solen.

1. Siliqua.
2. Novacula.
3. Ensis.
4. Vagina.
5. Pellucidus.
6. Legumen.
7. Fragilis.
8. Antiquatus.
9. Minutus.
10. Vespertinus.
11. Squamosus.

Genera and Species.

Gen. XXIX. Tellina.

1. Ferroensis.
2. Squalida.
3. Læta.
4. Donacina.
5. Tenuis.
6. Striata.
7. Fabula.
8. Similis.
9. Solidula.
10. Fausta.
11. Crassa.
12. Proficua.
13. Radula.
14. Bimaculata.
15. Lactea.
16. Rotundata.
17 Flexuosa.
18. Carnaria.
19. Maculata.
20. Polygona.
21. Laskeyi.

Gen. XXX. Pandora.

1. Inæquivalvis.

Gen. XXXI. Corbula.

1. Inæquivalvis.

Gen. XXXII. Cardium.

1. Edule.
2. Aculeatum.
3. Echinatum.
4. Lævigatum.
5. Nodosum.
6. Elongatum.
7. Exiguum.
8. Medium.
9. Rubrum.
10. Discors.
11. Muricatulum.
12. Arcuatum.
13. Edentula.
14. Fasciatum.

Gen. XXXIII. Cyclas.

1. Cornea.
2. Amnica.
3. Lacustris.

Gen. XXXIV. Mactra.

1. Solida.
2. Truncata.
3. Subtruncata.
4. Stultorum.
5. Cinerea.
6. Dealbata.
7. Triangularis.
8. Minutissima.
9. Glauca.

Gen. XXXV. Lutraria.

1. Vulgaris.
2. Hians.

Gen. XXXVI. Donax.

1. Trunculus.
2. Denticulata.
3. Complanata.
4. Plebeia.
5. Irus.
6. Castanea.
7. Rubra.

Gen. XXXVII. Venus.

1. Paphia.
2. Verrucosa.
3. Laminosa.
4. Striatula.
5. Islandica.
6. Chione.
7. Exoleta.
8. Undata.
9. Tigerina.
10. Sinuosa.
11. Ovata.
12. Minima.
13. Subcordata.
14. Granulata.
15. Deflorata.
16. Decussata.
17. Pullastra.
18. Perforans.
19. Virginia.
20. Aurea.
21. Sulcata.
22. Triangularis.
23. Spinifera.
24. Reflexa.
25. Orbiculata.
26. Dysera.
27. Compressa.
28. Scotica.
29. Danmonia.
30. Lactea.
31. Cassina.
32. Guineensis.
33. Substriata.
34. Subrhomboidea.

Genera and Species.

Gen. XXXVIII. Isocardia.

1. Cor.

Gen. XXXIX. Terebratula.

1. Vitrea.

Gen. XL. Nucula.

1. Nuclea.
2. Minuta.
3. Rostrata.
4. Tenuis.

Gen. XLI. Arca.

1. Lactea.
2. Noæ.
3. Fusca.

Gen. XLII. Pectunculus.

1. Pilosus.

DIVISION II. TOOTHLESS.

SECT. I. INEQUIVALVE.

Gen. XLIII. Pecten.

1. Maximus.
2. Jacobæus.
3. Opercularis.
4. Varius.
5. Lineatus.
6. Distortus.
7. Obsoletus.
8. Glaber.
9. Lævis.
10. Similis.
11. Fragilis.
12. Subauriculata.

Gen. XLIV. Ostrea.

1. Edulis.

Gen. XLV. Anomia.

1. Ephippium.
2. Aculeata.
3. Undulata.
4. Cymbiformis.

SECT. II. EQUIVALVE.

Gen. XLVI. Mytilus.

1. Edulis.
2. Ungulatus.
3. Incurvatus.
4. Pellucidus.
5. Modiolus.
6. Rugosus.
7. Precisus.
8. Crista-Galli.
9. Discors.
10. Discrepans.
11. Cygneus.
12. Anatinus.
13. Avonensis.
14. Plicatus.
15. Decussatus.

Gen. XLVII Pinna.

1. Pectinata.
2. Ingens.
3. Muricata.

ORDER III. MULTIVALVES.

DIVISION I. DENTATED.

Gen. XLVIII. Pholas.

1. Dactylus.
2. Parvus.
3. Crispatus.
4. Candidus.
5. Striatus.

Gen. XLIX. Teredo.

1. Navalis.

Genera and Species.

DIVISION II. TOOTHLESS.

SECT. I. OPERCULATED.

Gen. L. Balanus.

1. Communis.
2. Balanoides.
3. Punctatus.
4. Rugosus.
5. Clavatus.
6. Tintinnabulum.
7. Costatus.
8. Conoides.
9. Striatus.
10. Spongeosus.

Gen. LI. Coronula.

1. Diadema.

SECT. II. PEDUNCULATED.

Gen. LII. Lepas.

A.
1. Anatifera.
2. Anserifera.
3. Sulcata.
4. Fascicularis.
5. Membranacea.

B.
6. Scalpellum.
7. Polliceps.

SECT. III. IMBRICATED.

Gen. LIII. Chiton.

1. Marginatus.
2. Lævis.
3. Ruber.
4. Cinereus.
5. Albus.
6. Lævigatus.
7. Fascicularis.
8. Crinitus.

Formation of a collection of shells.

The formation of a collection of shells, is absolutely necessary to the successful prosecution of the science of Conchology. To accomplish this, much care and attention are requisite. Shells must be sought for in their natural situations, and obtained, if possible, with the animal alive. After the animal has remained dead in the shell for any length of time, it loses its lustre and transparency, and becomes less valuable, either as an object of beauty or curiosity. Hence the collector must explore the sea-coast, the land, and the fresh water, in search of the testaceous animals which they support, for the purpose of obtaining in a perfect state their calcareous coverings.

The sea contains more species of shells than either the land or the fresh waters, and presents to the conchologist an extensive field for observation. Many species of marine shells frequent the sea shore, adhere to rocks, stones, and sea-weed, or lodge in the clay or sand. These are termed *Littoral* shells, and are seldom found in deep water. The littoral shells are easily collected at ebb tide. Those which burrow in the mud or sand, may be detected by a small depression which they leave on the surface, as they retire below it. Other shells live in deeper water. To collect these, the dredge must be employed; and if the shells be put into sea water after they are brought up, the animals may afterwards be examined with ease. Such collectors as have not the advantage of a dredge, should examine the refuse of fishing boats, and traverse the sea shore, and search the rejectamenta especially after a storm of wind. The roots of the larger *Fuci*, especially F. digitatus which grows sometimes in four or five fathoms water, frequently contain a treasure of the rarer shells.

When vessels which have been long at sea come into dock to be cleaned, their bottoms are often covered

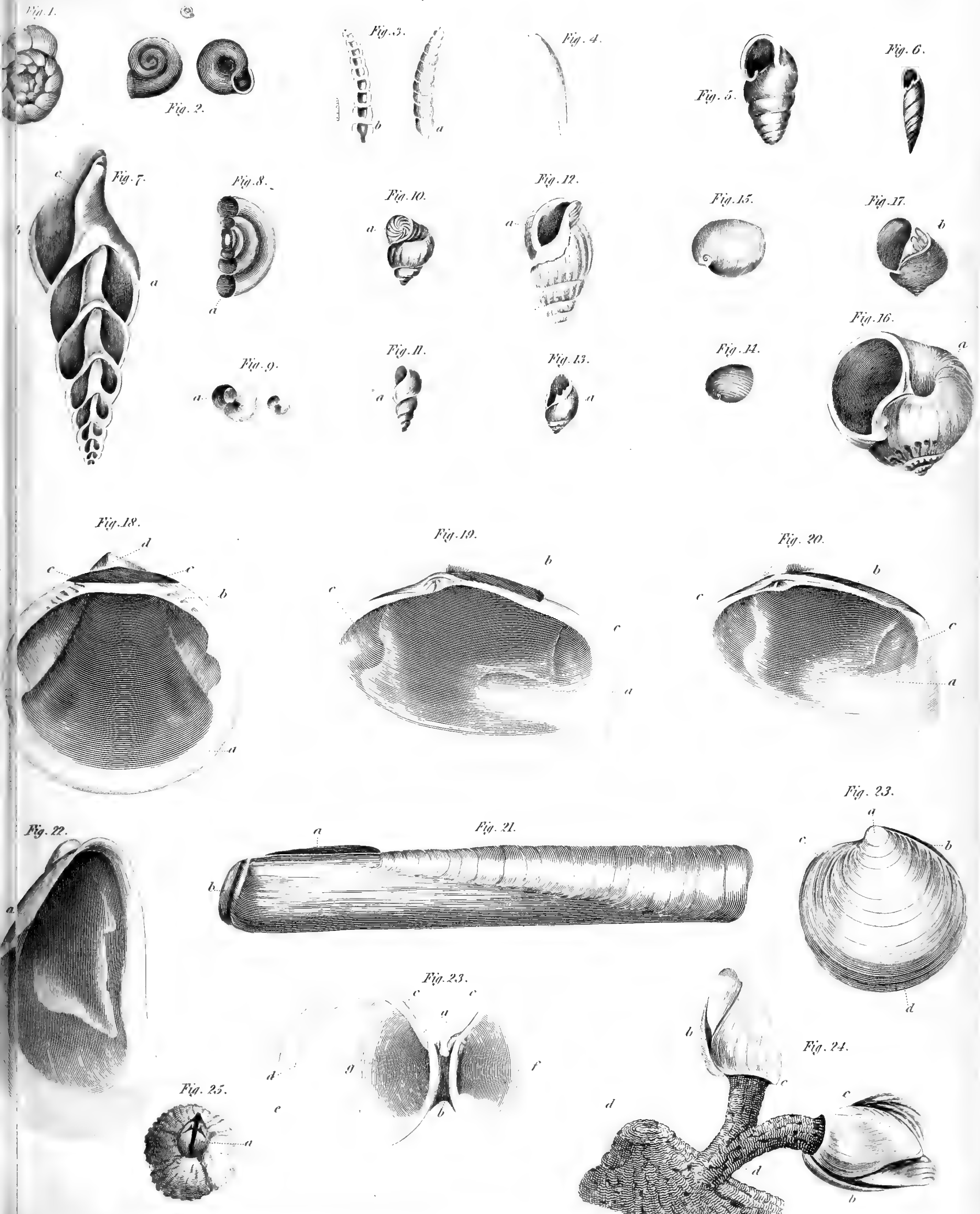
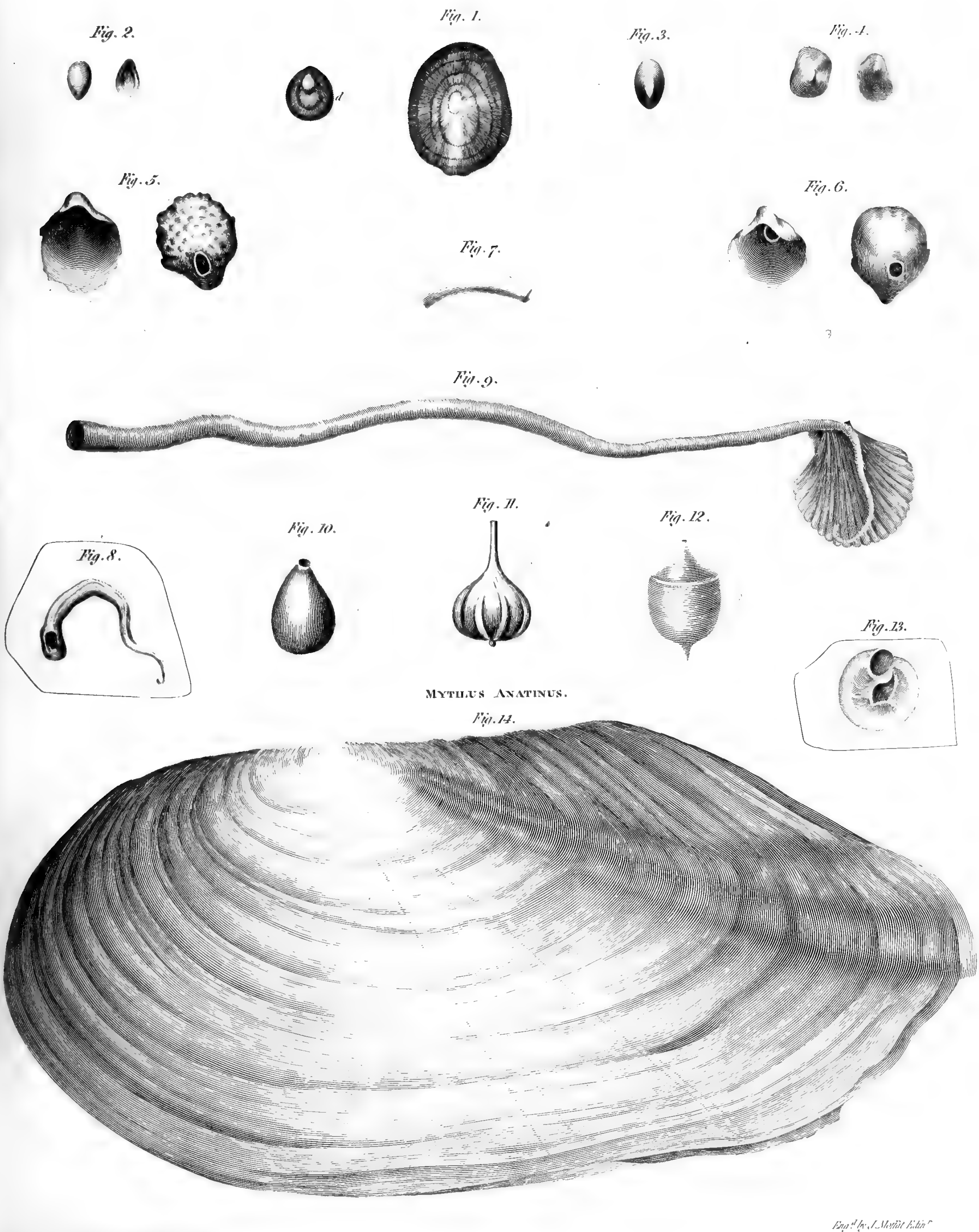


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.
Fig. 20.
Fig. 21.
Fig. 22.
Fig. 23.
Fig. 23.
Fig. 24.
Fig. 25.



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CONCHOLOGY. PLATE CCV.

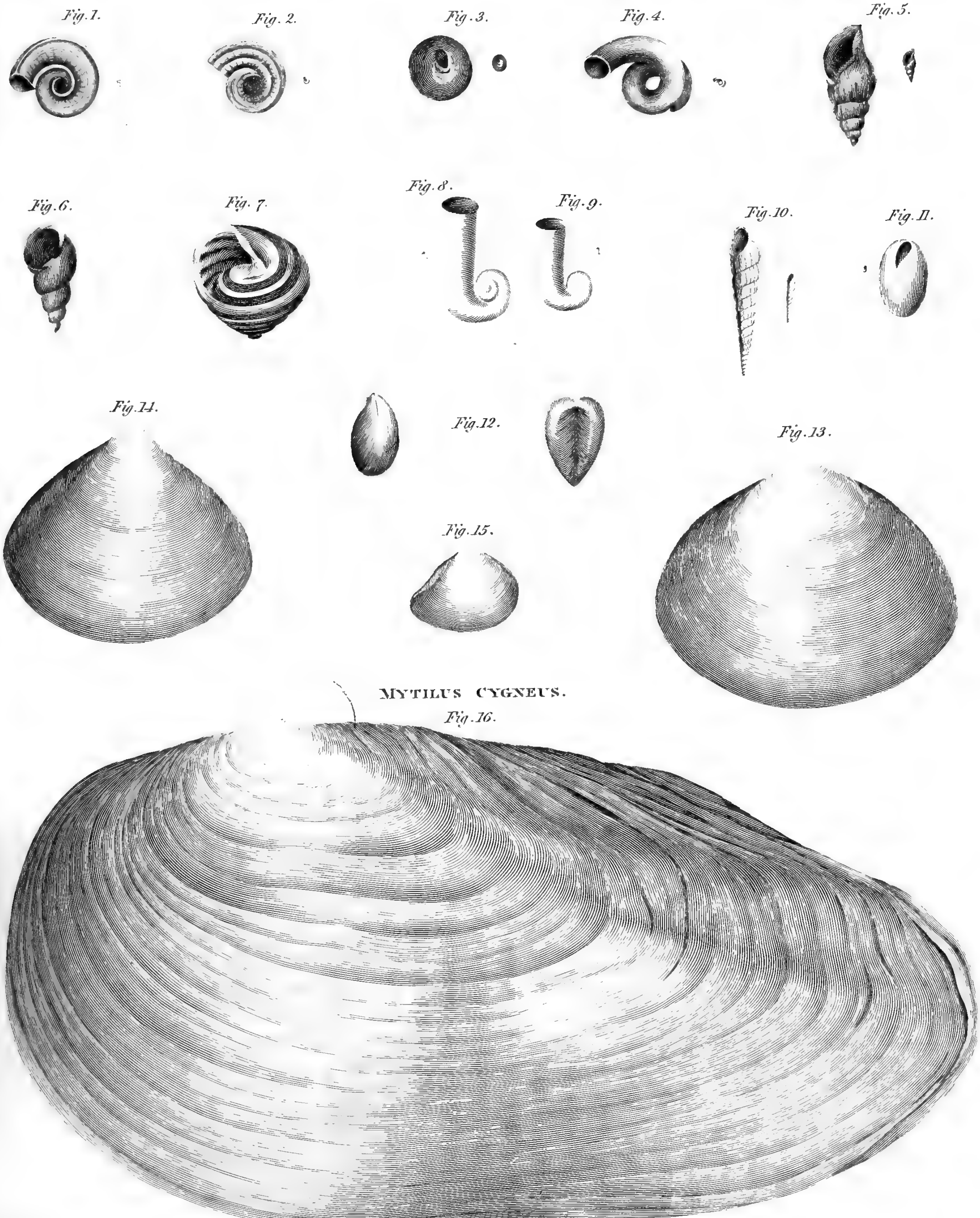

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Fig. 1.

Fig. 1.

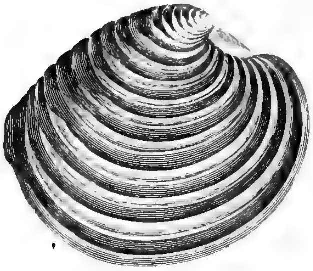


Fig. 1.

Fig. 4.

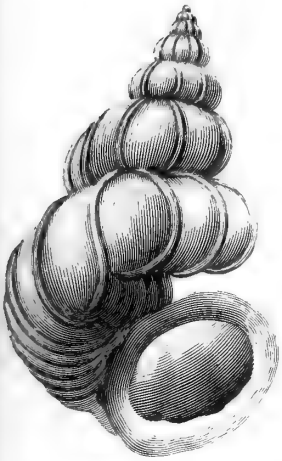


Fig. 2.

Fig. 2.

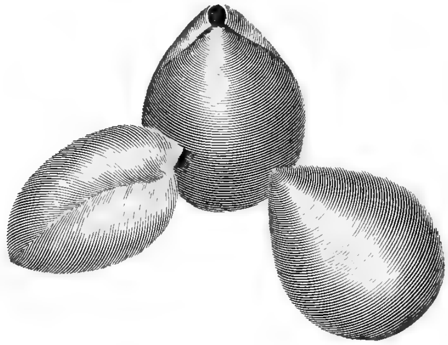


Fig. 2.

Fig. 5.

MYTILUS AVONENSIS.

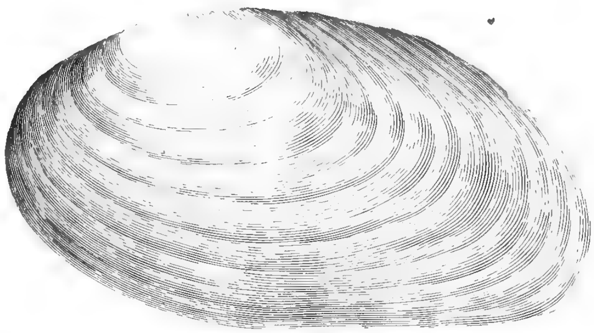
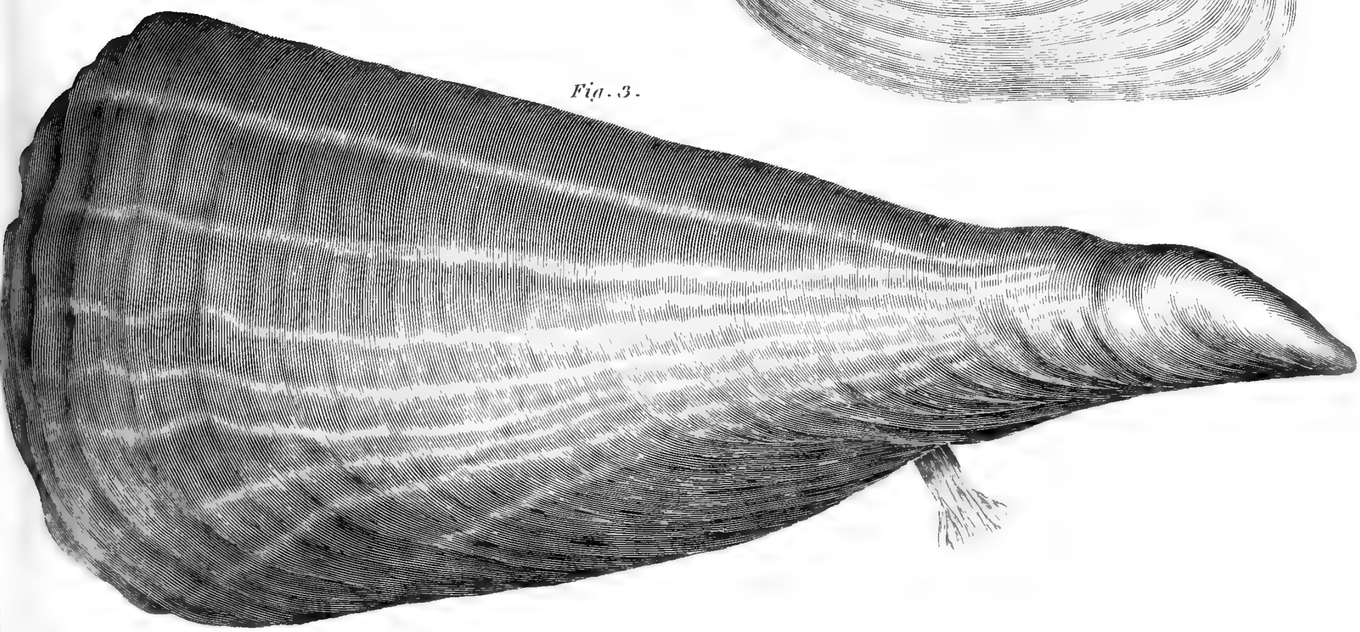


Fig. 3.



Drawn by M.F. for the Edin.^r Encyclopædia.

Eng.^d by J. Moffat Edin.^r

Formation of a collection of shells.

with shells, and with sea-weed, containing numerous rare vermes. To such situations the conchologist should resort; and in these he will often be successful in finding the objects of his pursuit. In illustration of this remark, we may mention the circumstance of the vessel employed at the Bell Rock as a floating light, having had her bottom covered with mussels three inches and a half in length, and upwards of one inch in breadth, although she had only been afloat three years and seven months. She was moored the 11th July 1807, and removed the 11th Feb. 1811. Previous to being moored, she was completely caulked and pitched. The sand on the shore likewise yields many of the smaller species of shells, and should be carefully examined with the microscope.

When sea shells are obtained, they should be plunged into boiling water, to facilitate the extraction of the animal, and afterwards soaked in it for some time to remove the salt. They should then be cleaned with a brush, and all extraneous matter removed. When the shells are not soaked in water, the salt soon attracts moisture, which speedily destroys the ligaments and epidermis.

The land shells are more within the reach of the scientific collector. To obtain these, he has only to examine the crevices of rocks, the trunks of trees, decayed wood, moss, and brushwood. In summer, after a shower, the land shells are most easily procured. The animals come forth to feed on the moistened blade, and at that time, from their motion, may be very readily perceived.

The land shells are very easily preserved. Almost all that is required is the extraction of the animal.

The fresh water shells, though less difficult to procure than the sea shells, require more trouble than the land shells. A piece of gauze spread over a ring attached to the end of a staff, forms a very convenient net for fishing fresh water shells. By means of this net in the drought of summer, almost all the different species of fresh water shells may be obtained with ease.

Distribution of shells in a cabinet.

The fresh water shells are frequently covered over with slime or mud, which must be removed by a brush; and the animal may be extracted after the shell has been plunged in boiling water.

The mode of distribution of shells in a cabinet, must depend on the views of the collector. The method of keeping them is more obvious. The Bivalves and Multivalves should be disposed of in a similar manner. Each species should be placed in a box or paper case, by itself, with a label containing its name, habitat, and locality. The Univalves may also be kept in the same way. They may likewise be pasted on slips of card, each species separately, with the necessary remarks on the back of the card; or, when small, they may be stuck upon a narrow slip of pasteboard, through which a pin passes, and stuck in drawers or boxes lined with cork, in a way similar to that employed by entomologists for preserving insects.

If it is wished to have a few of the specimens of shells polished, the following methods may be employed for the purpose. If shells have naturally a dull polish, this may be heightened, by rubbing hard with the hand, or a bit of leather. When shells are rough, they may be rubbed smooth with pumice stone, and afterwards polished with crocus or tripoli; or the roughness, especially the epidermis, may be in part removed by weak acids. Where shew is the object, these polished specimens may be much admired; but where a correct taste prevails, the rough unpolished surface will be more highly prized.

Plates CCIII. CCIV. CCV. CCVI.

For an account of the structure and constitution of testaceous bodies, we refer our readers to the article Shells; and in Plates CCIII. CCIV. CCV. CCVI. he will find figures of a few of the more remarkable species which we have described. (J. F.)

Concinnous, Concords.

CONCINNOUS Intervals, in Music, are such as are apt and useful in composition or harmony, as the VIII, V, 4th, VI, III, 3rd, and 6th; and the II, VII, 7th, 2d, and IV. or 5th; in contradistinction to the Inconcinnous, or *comma-redundant*, or *comma-deficient* Intervals of these names, as VIII', V', 4', &c. or VIII`, V`, 4`, &c. The term concinnous is also sometimes used in describing musical performances or concerts, to express a very nice or perfect execution of what the composer intended; in which, not merely a mechanical exactness is given to the performance of every passage, but where the several performers enter into the very design and sentiment of the composer, and where the whole orchestra move, as though one soul inspired the whole. (ρ)

CONCORDS, in Music, or *Consonant Intervals*, are such as have a pleasing effect on the ear, whether their limiting notes are heard in succession or melody, or are sounded together in consonance or harmony. A knowledge of the true principles, on which this peculiar property, of certain consonances or intervals, called concords, depend, by which they affect the ears of all persons (though in different degrees,) with delight and pleasure, while the greater part of the other musical intervals have a contrary effect, or excite a grating and rather disagreeable sensation on the ear, and are called *discords*, remains yet among the *desiderata* in this science; we have said the greater part of the other musical intervals rank as discords, because, for reasons that seem still more difficult to discover, all the concords admit of a slight deviation, either as to excess or defect, without becoming actually disagreeable, nor indeed do their peculiar characters seem to be much altered, except by the obtrusion of a periodical noise, or audible phenomena, called a *beat*, or beatings, very different from a musical sound, that accompanies the hearing of all such imperfect or *tempered concords*; and such beats vary in their frequency of occurrence, and disagreeable effect, with (though not *proportionate to*) the degree of imperfection in such imperfect concords. See our article Beats.

Concords.

This phenomenon, of slow and audible beats, which accompanies the concords, when slightly altered from their true ratios or perfection, has been proposed by some, as a character of concord; but as this requires the same test, viz. an appeal to the sense of hearing or the judgment of the ear, to discover its existence, as it does to discover their pleasing effect, it fails of that general characteristic, or inherent property, which ought to discover itself in the ratios or other methods of expressing musical intervals, that have not actually been heard;

and discover beforehand whether they would prove concords or discords.

The concurrent experience of all musicians, and of others who have experimented on musical sounds and consonances, is, that the following intervals are concords, viz.

I	2 S+𝔖	3rd	𝒮	III	S	4th	S+𝔖	V	S	6th	𝒮	VI	2S+𝔖
$\frac{1}{1}$		$\frac{5}{6}$		$\frac{4}{5}$		$\frac{3}{4}$		$\frac{2}{3}$		$\frac{5}{8}$		$\frac{3}{5}$	

VIII	10th	x	11th	xii	13th	xiii	XV	17th	xvii	18th
$\frac{1}{2}$	$\frac{5}{12}$	$\frac{2}{5}$	$\frac{3}{8}$	$\frac{1}{3}$	$\frac{5}{16}$	$\frac{3}{10}$	$\frac{1}{4}$	$\frac{5}{24}$	$\frac{1}{5}$	$\frac{3}{16}$

xix	20th	xx	XXII	24th	xxiv	25th	xxvi	27th	xxvii
$\frac{1}{6}$	$\frac{5}{32}$	$\frac{3}{20}$	$\frac{1}{8}$	$\frac{5}{48}$	$\frac{1}{10}$	$\frac{3}{32}$	$\frac{1}{12}$	$\frac{5}{64}$	$\frac{3}{40}$

XXIX	31st	xxxi	32d	xxxiii	34th	xxxiv	XXXVI
$\frac{1}{16}$	$\frac{5}{96}$	$\frac{1}{20}$	$\frac{3}{64}$	$\frac{1}{24}$	$\frac{5}{128}$	$\frac{3}{80}$	$\frac{1}{32}$

38th	xxxviii	39th	xl	41st	xli	XLIII	45th	xlv	46th
$\frac{5}{192}$	$\frac{1}{40}$	$\frac{3}{128}$	$\frac{1}{48}$	$\frac{5}{256}$	$\frac{3}{160}$	$\frac{1}{64}$	$\frac{5}{384}$	$\frac{1}{80}$	$\frac{3}{256}$

xlvii	48th	xlviii	L, &c.
$\frac{1}{96}$	$\frac{5}{512}$	$\frac{3}{320}$	$\frac{1}{128}$, &c.

and that all the amazing variety of other intervals (except those *near* to any of these concords, as above mentioned) within these seven octaves, are *discords*.

Wherein it is observable, in comparing the terms of the ratios of all these concords in the lowest line, belonging to the intervals major and minor, as expressed above them in the first line, that the numerator, or least term of the ratio, *never exceeds* 5; and that in the third and all succeeding octaves in ascending, the numerators are 1, 5, 1 3, 1, 5 3 and 1. That 4 never appears as a numerator but in the first octave, and 2 only in the two first octaves. That the denominators, or largest term of the ratios of the concords in the above seven octaves, constitute the following series, when arranged,

viz.

1,	2,	$^{2}3$,	$^{2}4$,	$^{4}5$,	$^{2}6$,	$^{3}8$,	$^{2}10$,	$^{2}12$,	$^{3}16$,	$^{2}20$,	$^{2}24$,
	1	1	1	1	1	2	2	2	4	4	4

$^{3}32$,	$^{2}40$,	$^{2}48$,	$^{3}64$,	$^{2}80$,	$^{2}96$,	$^{3}128$,	160,	192,
8	8	8	16	16	16	32	32	32

$^{2}256$,	320,	384,	and 512.
64	64	64	128

The small figures prefixed, denoting the number of times that these occur as denominators, in these seven octaves. All the numbers in the above series will be found included in one of the following three *forms*, viz. 2^x, $2^x \times 3$, or $2^x \times 5$; where $2^0 = 1$, $2^1 = 2$, $2^2 = 4$, &c. or *the powers of 2 are indefinite, while only the first power of 3 or of 5, enter into any of the largest terms of the ratios of concords.* If we examine the *differences* in the above series of numbers, it will be observed, that they are powers of 2, viz. 2^0 (or 1), 2^1, 2^2, 2^3, 2^4, 2^5, and 2^6; and that after the number 3, or third term of the series, they proceed by three of each of these, in succession; the consequence of three different forms being combined in this one series, as above.

In the middle line of the first octave, the *intervals* of the *original* concords therein, (as such are called,) are set down, viz. 2 S+𝔖, 𝒮, S, S+𝔖, S 𝒮 and 2 S+𝔖, in the Chromatic *Elements* (see that article); by which it appears, that the octave is similarly divided by the original concords, into two similar parts, but reversed; or, the progression is the very same in proceeding from both its extremities towards the middle of the first or original octave, and so of all the superior ones. It thus also appears, that where the numeral designation of the concords differ *two*, as between I and 3, and VI and VIII, the difference is S+𝔖, or the 3rd; where the same differ *one*, as between III and 4th, and V and 6th, the difference is S; and where the numerals are the same, only major and minor, as between 3d and III, and 6 and VI, the difference is 𝒮: these last have, by Dr Callcott, Dr Busby, and many other writers, most improperly and unnecessarily been called *imperfect* concords, merely because they are sometimes major and sometimes minor, and the VIII, V, and 4th *perfect*, because each of them have but one numeral designation; whereas *imperfect concords* should always mean *tempered* or altered concords, as above mentioned.

These several concords are not equally harmonious, satisfactory, or pleasing to the ear, either considered or compared altogether, or in groups, within each successive octave, respectively; but it seems agreed by Dr Robert Smith, Dr Robison, and others of the best modern writers on the subject, that their order of simplicity, or smoothness of effect on the ear, in the 1st octave, is I, VIII, V, 4th, VI, III, 3rd, and 6th; or $\frac{1}{1}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{5}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{5}{8}$; which ratios form series, increasing with the degree of comparative roughness or want of pleasing effect in the concord, as above, whether we contemplate the numerators, the denominators, or the *sum* of these, viz. 2, 3, 5, 7, 8, 9, 11, and 13. If we arrange all these several concords in seven octaves, according to the *sum of the terms* of their respective ratios, they will stand as follows, viz.

I	VIII	XII	V and XV	XVII	4th, X and XIX	VI
2,	3,	4,	5,	6,	7,	8
		V	VIII	III	III V	

III and XXII	3d, 11th, and XXIV	6th, XIII and XXVI
9,	11,	13,
VIII	4th III	VI V

10th and XXIX	18th	13th and XXXI	XX	XXXIII
17,	19,	21,	23,	25,
3d VIII	4th	6th III	VI	V

17th	XXXVI	25th	20th	XXXVIII	XXVII	XL
29,	33,	35,	37,	41,	43,	49,
3d	VIII	4th	6th	III	VI	V

24th	XLIII	32d	27th	XLV	XXXIV	XLVII	31st
53,	65,	67,	69,	81,	83,	97,	101,
3d	VIII	4th	6th	III	VI	V	3d

L	39th	34th	XLI	38th	46th	41st	XLVIII
129,	131,	133,	163,	197,	259,	261,	323,
VIII	4th	6th	VI	3d	4th	6th	VI

45th and	48th
389,	517
3d	6th

Where the middle line shews the sums of the terms in the concords expressed above, and the lower line the original concords, of which many of the same are compounded, by the addition of octaves. In comparing the first 16 terms of this complete series of concords, in the order of the sums of their terms, with the similar series above, when only the eight original concords in the first octave are considered; it will appear, that the XII or octave of the Vth is here interposed between the VIII and V; and the XV and XVII, or 2 VIII and VIII+III, are interposed between the V and 4th as they stood in the original concords, which superior simplicity of the doubled concords XII and XVII, to their respective originals, seems to point out one reason of these and the double octave being the only Tartinian sounds that are heard to accompany a note; since no other doubled concords but XII and XVII, have a less sum to the terms of their ratio, than their originals have. It is further observable, that X and XIX or VIII + III and 2 VIII + V, are interposed here, between the 4th and VI of the original series; that XXII or 3 VIII is interposed between III and 3d; and 11th and XXIV or VIII + 4th and 3 VIII + III between 3d and 6th.

Whatever confirmation Dr Smith's position (*Harmonics*, 2d edit. p. 21), respecting the comparative simplicity of the concords, as above, agreeing with their order as to smoothness and pleasant sensations that they excite on the ear, may receive from the preceding Tables, it must be plain, from an inspection of his general Table of the order of the simplicity of consonances, including both concords and discords, those beyond, or expressed by larger primes than 5, as well as those in the received system of music that involve no such large primes, that this is an imperfect and false rule of judging of the smoothness or harmoniousness of consonances in general, since in his table, the false tripled minor seventh of the trumpet, $\frac{1}{7}$, or 2 VIII + 7th—13.9471 Σ—*m*, occurs before the perfect VI, and the tripled major tone $\frac{2}{9}$, or 2 VIII + II, a discord, before the perfect 3d! which must be quite contrary to their comparative effects on the ear.

We should, perhaps, earlier have pointed out, from our series of the fifty concords in seven octaves, given above, that the three least, or 3rd, III, and 4th, being considered as the *simple* concords, or concordant elements, the three next largest, V, 6, and VI, are generated by adding these simple ones in pairs, in every possible way, and the next, or VIII, by adding the three together; and that every succeeding concord in the scale, is generated by adding an octave (3 + III + 4), or two octaves (2 3, 2 III, 2 4), or three octaves, &c. to each one of the seven original concords in the first octave. Whence it appears, that no concord but the octave will bear adding to itself once, or any greater number of times, (without other combinations,) without becoming a discord; but that the addition once, or any greater number of times of the octave, to any concord, will produce another concord.

That the complement, or remainder, when any one of the original concords is taken from the octave next above, or VIII, or from any of the succeeding octaves, the remainders are all concords; and so are the complements of any of the doubled, tripled, quadrupled, &c. concords in the second, third, fourth, &c. octaves, to the next, or any succeeding octave above them; and in like manner, in the second, third, fourth, fifth, &c. octaves, one or more VIII^{ths} may be taken away from any of the concords therein, and still leave remainders that are concords, &c.

Among the various attempts of philosophers to define the limits, or shew characteristic distinctions between concords and discords, generally, Mersenne and Kircher maintained, that those consonances are most simple or agreeable which are generated in the least time, or have the smallest least terms to their ratios; and those, on the contrary, the most compound and harsh, which are generated in the largest time, or have the largest least term or numerators to their ratios. This rule is shewn, however, by Malcolm, to be defective; and Dr Smith has done the same thing, and thence concludes, "that the frequency of coincidences is of itself too general a character of the simplicity or smoothness of a consonance, and therefore an imperfect one." (*Harmonics*, p. 23.) In another place, Dr Smith says, (p. 15.) that it is the "mixture of pulses succeeding one another in a given cycle of times, terminated at both ends by coincident pulses, and sufficiently repeated, which excites the sensation of a given consonance;" and "one consonance may be considered as more or less simple than another, according as the cycle of times belonging to it, is more or less simple than the cycle belonging to the other."

M. Euler says, when the ear readily discovers the relation subsisting between the terms of the ratios of two notes, their combination is denominated consonance or concord; and if it be very difficult, or even impossible, to catch this relation, the combination is termed dissonance, or discord." *Letters*, vol. i.

Mr Holder attempts, but without any success, to account for the pleasure derived from concords, or sounds in the more simple musical ratios, by the mind being occupied in parcelling out the numbers, but not by *division*, (which with primes is indeed impossible,) but by unequal and fanciful partitions of them into what he calls factors or parcels, as 5 into 2, 1, 2, 7 into 3, 1, 3, &c.; and principally on this whimsical ground, he labours to shew, that 7 ought to have place among musical ratios! &c. "No combination," says he, "ought to be esteemed *concord*, however simple and eligible its terms may be in every other respect, if the implied sound (that is, its grave harmonic) be three octaves or more below the lower term." *Essay*, p. 376. And again, "An interval which is concord in the upper parts, is often no concord when taken in the bass!" for "we lay it down as a rule, that the implied sound of a concord ought always to be within the limits of audible sound." The introduction of which last absurdities into his Essay, Mr Farey has shewn to have arisen, from Mr Holder being unacquainted with the true nature of the grave harmonics, or the rule for calculating those belonging to any assigned consonances.

Dr Robison says, "a musical sound is the sensation of a certain form of the aërial undulation which agitates the auditory organ. The perception of harmonious sound, is the sensation produced by another definite form of the agitation: This is the composition of two other agitations; but it is the compound agitation alone that affects the ear, and it is its form, or kind, which determines the sensation, making it pleasant or unpleasant, or in other words a concord or a discord." Our limits will not admit of enlarging further on this very curious and intricate subject, which presents yet a rich field for the successful cultivator of it. (ϱ)

CONCORDANT Elements, in Music. Consonant elements, or *simple* concords, are the minor and major third, and the minor fourth, 3rd, III, and 4th, or three least concords, which by addition form all other concords that are known; every combination of them, singly, by two's and by three's, being concords, &c. as shewn in the article Concord. Intervals when expressed in the notation by *concordant elements*, are capable of being tuned by means of perfect concords only, on instruments like the euharmonic organ of Mr Liston, having a sufficient number of pipes. (ϱ)

CONCUSSION. See Surgery.

CONDALIA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 177.

1

CONDAMINE, Charles Maria de la, a celebrated French traveller and philosopher, was born at Paris on the 28th January 1701, and was the son of Charles de la Condamine, receiver-general of finances for the province of Bourbonnois, and of Margaret Louisa de Chources. At an early age he was sent to school, where he exhibited no marks either of industry or talents; and he was afterwards instructed in literature and philosophy at the College of Louis le Grand, under P. Porée and P. Brisson, the latter of whom, even so late as 1717, still taught the philosophy of Descartes.

After quitting college, Condamine went as a volunteer to the siege of Roses in 1719, along with his uncle the Chevalier de Chources, who was captain of the Dauphin's regiment of cavalry. In the course of this siege, Condamine displayed a degree of courage bordering on temerity; and he was on one occasion found upon an eminence, examining through a telescope one of the enemy's batteries, the balls from which were falling thick around him. This carelessness and contempt of danger, which was afterwards a predominant feature in the character of our author, he had exhibited on a very different occasion, and at an early period. When he was scarcely twelve years of age, he went on a visit to the country; and having learned, that one of the fields near the house where he lived was visited by an apparition, he requested two of the domestics to conduct him to the park. They had scarcely reached the spot, when his two attendants fled with terror at the sight of the apparition, who, clothed in white, advanced towards them. Condamine kept his position, and having drawn a sword which he had concealed under his coat, he broke it in pieces upon his spiritual opponent. "The phantom is corporeal," he cried, "and has broken my sword." The coachman instantly emerged from his white covering, and acknowledged, that the plan was laid to try the courage of Condamine.

Although Condamine was particularly qualified for a military life by his intrepidity and personal courage, yet the ardour of his mind, and his indefatigable curiosity, prompted him to abandon a profession which, in the time of peace, presented few opportunities for the gratification of his favourite views. He henceforth resolved to devote himself to the sciences; and in the year 1730, he was admitted into the Academy of Sciences as adjunct chemist, and was already well known as one of the most active members of the Society of Arts, established at Paris by the Count de Clermont.

In the year 1731, Condamine embarked on board the squadron commanded by M. du Guay-Trouin, and visited many parts of the Mediterranean, and the coasts of Africa and Asia. In his way from Jerusalem to Constantinople, Condamine stopped at Bassa, the ancient Paphos. A Greek, who had been in the same vessel with him, was taken suddenly ill, and entrusted Condamine with 50 piastres, to be given to his parents. The Cadi of the place having insisted on appropriating this money to his own use, Condamine protested that he would give it no person but to the parents of his companion, and immediately set off for his vessel. A Titafa, an officer of police, with a numerous detachment, attempted to arrest Condamine and his servant; but after having resisted their attempts for some time, they at last sought for safety in flight, and, favoured by the darkness of the evening, they escaped to a boat, and endeavoured to regain their vessel. Finding it impossible, however, to reach the ship before break of day, and being exposed to the fire of the fort and of the Turkish vessels, they were compelled to surrender, and were carried half naked before the officer of police, who again demanded the 50 piastres. Condamine persisted in refusing them, complained of the barbarous treatment he had received, and threatening the Titafa with the vengeance of the Divan, he was at last set at liberty. After remaining five months at Constantinople, he returned to Paris, and published some account of his travels in a paper read to the Academy, and entitled *Observations Mathematiques et Physiques faites dans un Voyage du Levant, en 1731 et 1732.* Another account of his travels was published in 1734, by his valet de chambre, and without the consent of Condamine.

The Academy of Sciences was now charged with the splendid undertaking of measuring a degree of the meridian and of the equator in Peru; and Condamine, who had the honour of proposing the expedition, was one of the academicians who were selected for carrying it into effect. We have already had occasion to give some account of this great enterprize; and in another part of our work our readers may expect very satisfactory and copious details; but we can only at present relate the events which are particularly connected with the personal history of Condamine, and which could not be introduced with propriety under another head.

The academicians set out from Rochelle on the 16th of May 1735, and they reached Martinique on the 22d of June. On the day fixed for their departure, Condamine was seized with a violent fever; but such was the zeal of all the party to prosecute the object of their mission, that Condamine was embarked in the course of 24 hours after he was attacked. From Martinique the academicians went to Portobello; and, crossing the isthmus of Panama, they embarked at this city, and afterwards reached Guaquil, from which it was necessary to proceed to Quito by land. In order to examine as wide an extent of country as possible, Condamine separated from his companions, and chose a dangerous and difficult route. He traversed immense forests on foot; and after being abandoned by his guides, he wandered eight days in the deserts, without any other guide but his compass, and without any other food but the wild herbs that grew around him. After undergoing incredible dangers, and suffering the greatest privations, he at last joined his companions at Quito.

The pecuniary resources of the academicians were now unfortunately exhausted. Condamine had, however, brought with him particular letters of credit; but as there was no direct intercourse between Quito and Europe, he found it necessary to undertake a journey of 400 leagues to Lima, for the purpose of obtaining money. After an absence of three months, he returned to Quito with 60,000 livres, for which he was personally responsible, and with 20,000, which were sent to him by the council and the viceroy; and although he was obliged to carry his own bed, yet he found time to compose a memoir on the tree which yields Quinquina, and to collect a number of curious observations.

The geometrical mensuration of the arc of the meridian was completed in August 1739, after two years of unremitting labour; and the academicians were proceeding to take the astronomical measure of this arch, Condamine. when their attention was called to a most distressing event. M. Seniergues, who accompanied the expedition as surgeon, had a personal quarrel with the Alcade of Cuenca, who had interested the Grand Vicar of Cuenca in his quarrel. At a bull-fight, in August 1739, where a number of people were collected, the Spanish officers instigated the populous to the assassination of Seniergues; and, notwithstanding the great exertions of Condamine to bring them to justice, and the partial success which he at last obtained, the culprits continued to evade the sentence of the law, by means which could succeed only under the most corrupt and infamous governments.

While M. Godin was making observations on the meridian to the north, M. Bouguer repeated in the south the observations which he had formerly made, and detected an error, to the amount of 30″, which he had committed, with the cause by which it had been produced. This circumstance gave rise to a difference between Bouguer and Condamine, the former of whom maintained, that the method of detecting and providing against the error of 30″ belonged to himself alone. Condamine maintained, that Bouguer had no title to appropriate this honour to himself; and therefore carefully repeated all the second observations of his companion. In these labours they were engaged till 1743.

On the 4th of September 1742, Condamine set out from Quito. A few days before his departure, he had been robbed of his papers, the result of eight years of incessant labour; but though his money and jewels were also carried off, he had the prudence to publish a notice, declaring that he demanded only his manuscripts. This notice had the desired effect. The papers were restored, with the exception of two packets, which contained an account of his travels to the mountains where gold mines were supposed to exist.

M. Condamine left Peru on the 11th of May 1743, and he came to the hazardous resolution of returning home by the river Amazons, attended by a single domestic. After a series of dangers, for an account of which we must refer to his own work,* he arrived at Cayenne, and waited more than five months for a vessel to carry him to France. This delay preyed so much upon his mind, that it began to produce a serious impression upon his health, just when the governor of Surinam announced to him an opportunity of returning to Europe. He landed at Amsterdam, and soon found himself among his friends at Paris.

The jealousy between Bouguer and Condamine, which had already shewn itself in Peru, was again roused upon the arrival of the latter. The interest which he excited among the gay circles of Paris by the singularity of his travels, by the personal courage which had uniformly sustained him, and by his great powers of conversation, made his company very generally courted, while the mighty pretensions of Bouguer were in a great measure overlooked. To a person acquainted with human character, this unequal distribution of praise would have occasioned no uneasiness; but Bouguer possessed little knowledge of the world, and he ceased to support the dignity of his character when he repined at the admiration which was lavished upon his friend. Every person was capable of estimating the talents, and of being instructed by the conversation of an active and eloquent traveller like Condamine, while it is Condamine. the lot of few to appreciate the immortal labours by which Bouguer has enriched the sciences. The dazzling recompence of specious talents and superficial acquirements perishes with the gay crowds by whom it is conferred; but it is the splendid destiny of genius, that its rewards and its labours are alike eternal. The one is like the gaudy arch which vanishes with the shower that gives it birth; the other like the circle of the galaxy which keeps its place in the firmament, and shines with a sober but unextinguishable light.

When the quarrel between the two academicians was brought to a close, Condamine devoted his attention to the subject of an universal measure. He proposed to employ as an unit the length of a pendulum vibrating seconds under the equator, a plan which was afterwards adopted at the Revolution.

In the year 1754, Condamine became a keen supporter of the system of inoculation for the small pox, which had already been extensively practised in England and Holland. He published a Memoir on the subject, in the Memoirs of the Academy, and also a collection of papers upon the same subject.

In the year 1757, he undertook a journey to Italy for the benefit of his health, and upon his return to Paris he read to the Academy a paper entitled *Extrait d'un Journal de Voyage en Italie*, which contained much curious information. Having employed himself when at Rome in fixing the dimensions of the principal Roman edifices, he was then led to an examination of the ancient measures of length, which he endeavoursd to determine on the hypothesis, that every leading part of an ancient building would contain a round number of the given measure. His attention was also directed to the geognostic structure of Italy, and he examined with care the remains of its extinct, volcanoes, and the interesting phenomena exhibited by Vesuvius. In the course of his journey he obtained a dispensation to marry his own niece, a connection which tended greatly to promote his future happiness.

He was received a member of the Academy of Inscriptions and Belles Lettres in 1760, and he contributed greatly to the last edition of the Dictionary. On this occasion he published Letters on Dictionaries and on Education.

In 1763 Condamine went to England. He had been elected a Fellow of the Royal Society so early as the 15th December 1748, and he was now admitted on the 12th of May 1763.

Soon after his return from England, Condamine was attacked with a great insensibility in his extremities. He was now unfit for any laborious occupation, and he occasionally amused himself in the composition of poetry. Several of his tales in verse were published in the periodical journals, and likewise a translation of part of the Æneid of Virgil. In addition to the paralysis of his extremities, he was attacked with hernia, and he was unfortunately prevailed upon by an empiric, to attempt its cure by the application of caustics. He died, however, of the effect of the operation, 45 days after it was performed, on the 4th of February 1774, in the 73d year of his age.

M. Condamine was Knight of the Royal Military Order of Notre Dame and Mount Carmel, and of St Lazarus at Jerusalem. He was elected a member of

* *Relation abregée d'un Voyage dans l'Interieur de l'Amerique Meridionale, depuis la cote de la Mer du Sud, jusqu'aux cotes du Bresil, et de la Guyane, en descendant la Riviere des Amazones.*

the academies of Petersburgh, Berlin, Bologna, Cortona, and Nancy, and he was honorary secretary to the Duke of Orleans.

The personal appearance of Condamine was by no means interesting. His face was greatly disfigured by the ravages of the small-pox, but his vivacity and fluency in conversation amply compensated for this defect in his bodily appearance. Condamine does not seem to have possessed any of that inventive genius which enriches and extends the sciences by great and original views. Though he acquired a general knowledge of all the sciences, yet he did not attach himself with sufficient attention to any of them. The activity and ardour of his mind were constantly hurrying him into labours which required the exercise of those great qualities. His mind was of a texture too chivalrous for the peaceful pursuits of science; and we are strongly impressed with the opinion, that he forsook his own destiny when he exchanged the sword for the level and the plumb-line. In estimating therefore the claims of Condamine upon posterity, we cannot deny him the praise of possessing a bold, active, and intrepid mind, which was constantly exerting itself for some great and important object, and which surmounted every danger and difficulty that obstructed its accomplishment. His knowledge was extensive, and in some cases profound; and as a writer, his style was easy, simple, and elegant. But he can lay no claim to those higher qualities of the mind which can alone conduct the philosopher into the Elysium of invention and discovery.

The following is a correct list of his papers, which are published in the Memoirs of the Academy of Sciences.

Observations sur une nouvelle manière de considerer les sections coniques, 1731, p. 240.

Observation sur une nouvelle espèce de végétation métallique, 1731, p. 466, H. 31.

Observations mathématiques et physiques, faites dans un voyage du Levant en 1731 et 1732. 1732, p. 295.

Description d'un instrument qui peut servir à déterminer sur la surface de la terre, tous les points d'un cercle parallèle à l'équateur, 1733, p. 294. H. 53.

Nouvelle manière d'observer en mer la declinaison de l'aiguille aimantée, 1733, p. 446.

Recherches sur le tour, Premier mémoire, 1734, p. 216.

Second mémoire, 1734. p. 295.

Addition ou mémoire qui a pour titre: Nouvelle Maniere d'observer en mer la declinaison de l'aiguille aimantée; extrait d'une lettre de M. De La Condamine, de Saint Domingue, le 15 Juillet 1735, 1734 p. 597.

Manière de déterminer astronomiquement la différence en longitude de deux lieux peu éloignés l'un de l'autre, 1735. p. 1.

De la mesure du pendule à Saint Domingue, 1735. p 529.

Observations sur l'arbre du Quinquina, 1738. p. 226.

Relation abrégée d'un voyage fait dans l'intérieur de l'Amerique méridionale, depuis la côte de la mer du Sud, jusqu'aux côtes du Brésil et de la Guane, en descendant la rivière des Amazones, 1745, p 391. H. 63.

Extraits des operations trigonométriques, et des observations astronomiques, faites pour la mesure des degrés du méridien aux environs de l'équateur, 1746. p. 618.

Nouveau projet d'une mesure invariable, propre à servir de mesure commune à toutes les nations, 1747, p. 489. H. 82.

Mémoires sur une résine élastique, nouvellement découverte à Cayenne, par M. Fresneau; et sur l'usage de divers sucs laiteux d'arbres de la Guiane, ou France équinoxiale, 1751. p. 319. H. 17.

Memoires sur l'inoculation de la petit vérole, 1754. p. 615.

Extrait d'un Journal de voyage en Italie, 1757. p. 336. H. 6.

Second mémoire sur l'inoculation de la petite vérole contenant la suite de l'histoire de cette méthode et de ses progrés de 1754, à 1758, 1758. p. 439.

Observâtions sur l'amiante très-blanche, trouvée dans les montagnes de la Tarentaire, 1761, H. 31.

Suite de l'histoire de l'inoculation de la petite vérole, depuis 1758, jusqu'en 1765. Troisième memoire, 1765. p. 505.

Observations de M. Spallanzani, sur des limaçons à qui on avoit coupé la tete, auxquels il en a poussé une nouvelle, 1768, H. 34.

Machine pour exécuter sur le tour toutes sortes de contours réguliers et irreguliers, Mac. T. 5. p. 83.

Machine pour tailler toutes sortes de Rosettes. Mac. T. 5. p. 89. (*o*)

CONDENSATION. See EXPANSION.

CONDENSER. See ELECTRICITY and PNEUMATICS.

CONDENSER OF FORCES, is the name of a contrivance invented by M. Prony for obtaining from a first mover the greatest possible effect. See MECHANICS.

CONDILLAC, STEPHEN BONNET DE, a celebrated French metaphysician, whose writings throw around his name a distinguished lustre, while his private history is involved in singular obscurity. He first became known to the world as an author in 1746, when he published his "*Essay on the Origin of Human Knowledge.*" His object in this work is to develope the faculties of the human mind, by tracing historically the progress of its operations. In his next work, entitled, "*A Treatise on Sensations,*" he endeavours to account for the origin of memory, judgment, and the mental affections, and the gradual formation and correction of sensible ideas, by imagining to himself a statue, provided at first with a single sense, and with the others in succession. The fame of his writings had procured him the honourable situation of preceptor to Don Ferdinand, Prince of Parma, for whose instruction he drew up a "*A Course of Study,*" &c. which he afterwards published in 16 duodecimo volumes. In the introduction to these volumes, he enters into a discussion of the comparative advantages of the different modes of instruction, judiciously giving a decided preference to the mode of advancing gradually from particular facts up to general principles. Logic, metaphysics, and the philosophy of the human mind, are comprehended among the earlier stages of this course of study; from which he proceeds to the study of history, of which he has given an ample and well-arranged abridgment, in eleven volumes. Condillac likewise published a "*Treatise on Animals,*" in which he endeavours to refute the notions of Descartes and Buffon, concerning the mechanical nature of brutes, and to shew in what manner their faculties are derived; and a small work, entitled, "*Commerce and Government considered relatively to each other.*" He died in 1780, leaving behind him a splendid reputation, deservedly acquired by the extent of his knowledge, the soundness of his judgment, and the clear and comprehensive views which he took of every subject towards which his mind was directed. (*k*)

Condorcet. **CONDORCET, Jean Antoine Nicolas de Caritat, Marquis de**, a celebrated mathematician and philosopher, was descended of an ancient and noble family, and was born at Ribemont in Picardy, on the 17th of September 1743. He received his education at the College of Navarre, where he was distinguished among his fellow students for his ardour in the acquisition of knowledge, and for his extreme partiality to mathematical and physical pursuits. In the year 1765, when he was in the 22d year of his age, he published his *Traité du Calcul Integral*, in which he proposed to give a general method of determining the finite integral of a given differential equation, either for differences infinitely small, or for finite differences. This work, which is noticed in the History of the Academy for 1765, (p. 54.) had the honour of being praised by D'Alembert and Bossut, who were employed by the Academy to examine it. They stated that the greater part of the methods were invented by Condorcet; that it exhibited a degree of knowledge rarely to be met with at so early an age; and that it afforded a presage of talents which the approbation of the Academy could not fail to excite. This work was followed by his *Essais d'Analyse*, in four parts, the first of which was published in 1765, the second in 1767, and the third in 1768. This work relates principally to the system of the world, and to the solution of the problem of three bodies; but these subjects, as La Lande has already remarked, are treated with a generality which is insufficient for astronomy. On the 8th March, 1769, he was admitted into the Academy of Sciences as joint mechanician, and as associate on the 22d December 1770; and in this situation he formed a friendship with D'Alembert which lasted during his life. He was appointed, along with D'Alembert and Bossut, to assist the celebrated Turgot in his financial calculations; and about the same time he wrote, under the title of *Lettres du Laboureur*, a reply to Necker's essay on the corn laws, entitled *De la Legislation et du Commerce des Grains*, and he published an anonymous defence of the political sect to which he had attached himself. This last work was entitled *Lettres d'un Theologien à sons fils*, and was intended as an answer to the Abbe Sabbatier's *Dictionnaire des Trois siecles de notre Literature*. It contains a great deal of unmanly and illiberal abuse, directed against religion and its ministers; and, as if even this was not a sufficient display of his opinions, he afterwards published his *Commentaire des Pensées de Pascal*, which is filled with the principles of the most determined atheism.

In 1773 he published, at Paris, the *Eloges des Academiciêns de l'Academie Royale des Sciences mort depuis* 1666 *jusqu'en* 1699. This work contains the lives of Huygens, Picard, and Roemer, who were not included in the Eloges either of Fontenelle or D'Alembert, and, if we believe La Lande, was written at a time when he was ambitious of the secretaryship to the Academy of Sciences, and with the view of shewing that he was qualified for that important office. Influenced probably by the genius displayed in these eloges, as well as by the high opinion entertained of him by D'Alembert, the Academy appointed him adjunct secretary, with the reversion of that office, on the 10th of March 1773.

A vacancy having occurred in the French Academy by the death of M. Saurin, in 1782, Condorcet was proposed as a candidate by his friend D'Alembert, while M. Bailly, the celebrated author of the *History of Astronomy*, was supported with all the influence of the Count de Buffon. Bailly had been vanquished, at the last election, by M. Chamfort, by only three or four votes, and was therefore supposed to have the best chance of succeeding Saurin. D'Alembert, however, employed all his address and activity in the cause of his friend, and he at last succeeded in securing Condorcet's election by the single vote of M. de Tressan, at a meeting consisting of 31 members. This academician, who owed his place in the Academy to Buffon, had promised his vote both to Bailly and Condorcet, but D'Alembert, who was more acquainted with human character than Buffon, had the precaution of obtaining a written promise from M. de Tressan, and of thus securing a vote which might otherwise have decided the election of Bailly. The discourse which Condorcet delivered to the Academy at his admission, does not appear to have answered the high expectations of his friends. It related principally to the rapid progress of knowledge during the 16th century, and to the doctrine of the infinite perfectibility of the human mind, an opinion which seems to have decayed with the revolutionary spirit in which it had its origin, and which could be maintained only by men who were intoxicated with a false and extravagant estimate of their own powers.

In the year 1778, when the Academy of Sciences at Berlin proposed a prize for the best dissertation on the theory of comets, Condorcet transmitted an essay, which was however unsuccessful. It was published along with one of Tempelhoff's and two of Hennert's prize dissertations, in a quarto volume, entitled *Dissertations sur la Theorie des Cometes*. Utrecht, 1780.

Upon the death of D'Alembert in 1783, Condorcet succeeded, in virtue of his former appointment, to the Secretaryship of the Academy of Sciences, and in this office he distinguished himself by his Eloges on some of the most celebrated members. His Account of the Life and Discoveries of D'Alembert and Euler; his Eloge on the celebrated Turgot; his Life of Voltaire, which appeared in 1787; and his Biographical Account of Dr Franklin, which appeared in 1790, display a deep knowledge of science and of character, and exhibit the peculiar talent which Condorcet eminently possessed, of giving a perspicuous and comprehensive view of the labours and discoveries of others.

Amidst the duties of his new office, Condorcet did not forget his mathematical pursuits. His attention was turned particularly to the doctrine of chances; and he treated this subject in a series of four memoirs, entitled, *Sur le Calcul des Probabilites*, and printed in the Memoirs of the Academy between 1781 and 1785. He published also a separate work on the subject, entitled, *Essai sur l'application d'analyse à la Probabilité des Decisions*, 4to, 1785. In the application of the results of his investigations to the practical purposes of life, he examined the probability of an assembly's giving a true decision, and he explained the limits to which our knowledge of future events might extend, when regulated by the laws of nature. He supposed that we have, at least, a mean probability that the law indicated by events is constant, and will be perpetually observed. He regarded a forty-five thousandth part as the value of the risk, in the case when the consideration of a new law comes under our notice; and it results from his formulæ, that an assembly consisting of 61 voters, where it is requisite that there should be a plurality of nine, will fulfil this condition, if there is a probability that each vote is equal to five-fifths, that is, if there is a probability that each member shall be deceived only once in five times. These calculations he next applies to

Condorcet. the establishment of tribunals, to the forms of elections, and to the decision of numerous assemblies.

Condorcet was at this time employed, in conjunction with M. Sejour, and M. de la Place, in estimating the population of France; and the results of their labours were successively laid before the public in six memoirs, which were published in the Memoirs of the Academy, between the years 1784 and 1788.

About this time Condorcet had suggested the idea of a dictionary, in which objects are to be found by their properties, instead of by their respective names; and he at the same time gave notice of a scheme for constructing Tables, by means of which ten milliards of objects might be classed together by only ten different modifications.

Condorcet took an active part in the various political events which preceded and accompanied the French revolution, and his numerous writings on philosophical and political subjects are supposed to have accelerated that awful event. He conducted a work entitled *La Bibliotheque de l'Homme Public*, containing analyses of the works of the most eminent political writers; and a newspaper called *La Chronique de Paris*, which was filled with the most petulant declamation against royalty.

When the king of France fled to Varennes, Condorcet united himself with Brissot and Thomas Paine, two of the most determined republicans, and none of whom were members of the constituent assembly; and they commenced a periodical paper, called *Republicain, ou le Defenseur du Gouvernment Representatif*, which was filled with the most detestable principles. The papers written by Thomas Paine were translated by the Marchioness de Condorcet; but Condorcet was the principal contributor to this disgraceful publication. In one of the papers which he published in the *Republicain* Condorcet attempts to refute the argument in favour f a monarchical government, that a legal king is the best security against a tyrant, since a power limited by the constitution is less formidable than the undefined power of an ambitious usurper; and after adducing a variety of arguments to prove, that there is now less danger of usurpation than there was in the days of Sylla, Cæsar, Guise, and Cromwell, he maintains, that, in future, the art of printing, the liberty of the press, and the free communication of knowledge by means of newspapers, will *infallibly* preserve the human race from similar usurpations.* Condorcet lived long enough to see this contemptible reasoning completely refuted by the usurpation of Robespierre; and those who survived him have witnessed another refutation of it still more triumphant. It is thus that the great events of life are constantly putting to shame the speculations of that school of philosophy, which, ignorant of the true character and destiny of man, represents him as hastening to a state of perfection of which his nature is unsusceptible.

Condorcet was a staunch member of the Jacobin club, and he spoke frequently at its meetings. He was elected one of the representatives for Paris, at the dissolution of the Constituent Assembly; and his political views accorded, in general, with those of the Brissotine faction. He was called upon to digest a plan of public instruction, which he completed in two memoirs, replete with exalted and enlarged sentiments, though tinged with the peculiar views of their author. Condorcet. He was selected as the most fit person to draw up the manifesto which was addressed by the people of France to the powers of Europe at the commencement of the war; and he wrote a letter of expostulation to the king, as president of the assembly, which was marked by an unnecessary and an unceremonious severity. Condorcet is said to have vindicated the proceedings of the mob when they insulted the king at the Thuilleries; and when he was thus forgetful of his duty as a subject, he is reported to have been secretly soliciting the situation of tutor to the dauphin, which, on account of his open infidelity, the king refused to confer upon him. The enemies of Condorcet have accused him of being accessory to the murder of the Duke de la Rochefoucault, who was the near relation of his wife, and to whom he owed the most substantial obligations; but it is difficult to discover, from the total want of information on the subject, whether he was innocent or guilty of this heinous crime.

When the trial of Louis XVI. was the subject of discussion, Condorcet maintained that he could not legally be brought to judgment; yet, when sentence of death was pronounced upon him, he had not the courage either to defend or avow his former sentiments.

After the death of the king, the Gironde party employed Condorcet to frame a new constitution, which had the honour of obtaining the approbation of the convention; but it did not accord with the views of those whom it was intended to govern; and, in the opinion of others, who were less interested in the decision, it was filled with a series of those politico-metaphysical absurdities, which had been long dazzling the inebriated minds of the republicans. The Mountain Party now began to gain an ascendency over Brissot and his friends. During the violent struggle for power which ensued, Condorcet had the prudence to decline an active part; and, in consequence of his moderation, he was not included in the number who were sacrificed along with Brissot in 1793, when the arrest of the Girondists was decreed. He continued, however, to support his party by his writings, and on this account he incurred the displeasure of Robespierre, who ordered him to be arrested in 1793. Having contrived, however, to evade the vigilance of the officers under whose charge he was placed, he effected his escape, and remained in concealment at Paris during the space of nine months. Alarmed, however, lest a domiciliary visit should be instituted for the purpose of apprehending him, he escaped unobserved through the barriers, and sought refuge on the plain of Mont Rouge, in the house of a friend, who happened unfortunately to be at Paris. He was therefore compelled to spend two nights in the open fields, the victim of cold and hunger; and on the third day, when his friend arrived, he had the mortification of finding that he durst not venture to afford him shelter. Again driven for safety to the woods and fields, Condorcet was at last exhausted with fatigue and hunger, and was forced to apply at a public inn for an omelette, which he greedily devoured. His ghastly appearance and keen appetite having roused the suspicions of a municipal officer who happened to be present, and these suspicions being confirmed by the ambiguity and hesitation of his answers,

* *Pour tout homme qui a lu avec attention l'histoire de l'usurpation de Cromwell, il est evident qu'une seul Gazette eut suffit pour en arreter le succes, il est evident que si le peuple d'Angleterre eut su lire d'autres livres que la Bible, l'hypocrite, demasqué des ses premiers pas, eut bientot cessé d'etre dangereux.*

he was immediately seized and thrown into a dungeon, for the purpose of being conveyed next day to Paris. He was, however, found dead on the morning of the 28th March 1794, in consequence, as was supposed, of having taken poison, a dose of which he always carried about with him. Condorcet was survived by his wife, with whom he had always lived on the most affectionate terms, and by an only daughter, who was married in 1807 to Mr Arthur O'Connor.

Condorcet left behind him some posthumous works, which he had been prevented from publishing by the disorders of the French revolution. His *Esquisse d'un Tableau historique de progres de l'esprit humain* appeared at Paris in 1797, in one volume, and contained the same doctrine of the perfectibility of the human mind, which he had already supported in so many of his works. His other posthumous work is entitled *Moyens d'apprendre à compter surement et avec facilité*, and contains, in small compass, a very beautiful system of elementary arithmetic. It was adopted, by order of the French government, in all the national and private schools, and has been recently (1813) translated into English by Mr Elias Johnston, teacher of mathematics in Edinburgh. This little work is said to have been composed after Condorcet had concealed himself from his enemies, and to have been sent sheet by sheet to his wife.

Beside the works which have already been mentioned, Condorcet published, during his life, *Letters to the King of Prussia.* He was likewise engaged as a contributor to the *Encyclopedie*, and he assisted D'Alembert, Bossut, and La Lande, in writing the mathematical part of that celebrated work. His articles may be distinguished by the signature (M. D. C.) Condorcet had the honour of being elected a member of the Institute of Bologna, and of the Academy of Sciences at Turin.

In reviewing the events of Condorcet's life, it is no difficult matter to form a tolerably correct estimate of his attainments and character. He was deeply and extensively acquainted with the mathematical sciences; and the memoirs which he transmitted on these subjects to the Academy, contain the presages of a greater genius than he ever brought to maturity. As an elegant writer, he was scarcely inferior to his friend and associate the illustrious D'Alembert; and, had his ambition never carried him beyond the bounds of literature and science, his name might have been cherished by posterity, and ranked among those great men who have done honour to their species. But Condorcet aspired at still higher distinction. In the political state of his country, he perceived some distant prospect of reaching the object of his wishes, and he strove, both by his conduct and his writings, to accelerate that dreadful revolution in which he himself was destined to perish. Dazzled with false views of human character, his political writings are marked with opinions the most absurd and extravagant, and subversive of every species of social order and happiness; and, much as we are disposed to reprobate the calumnies which have been heaped upon the most illustrious of the French philosophers, we are compelled to admit, that Condorcet was an infidel, and even an atheist. Although he displayed the utmost courage in his writings, yet, when he was called to act, he evinced the greatest timidity and indecision. The restlessness of his mind instigated him to act a part which he had not fortitude to sustain; and the same timidity of disposition was conspicuous in the manner in which he died. It is impossible to think of the latter days of this celebrated man, without feeling acutely for the sufferings, under the pressure of which he put an end to his life; but it is impossible also not to acknowledge, that he perished in a tumult which he had been the most active to create.

The following is a list of the works written by Condorcet, which are either noticed or printed in the Memoirs of the French Academy:

1 *Traité du Calcul Integral.* 1765, Hist. p. 54.

2. *Du Probleme des trois Corps*, 1767, Hist. p. 93.

3. *Ecclaircissemens sur le Calcul Integral.* 1767, Hist. p. 95.

4. *Sur la nature des suites infinies, sur l'etendue des solutions qu'elles donnent, et sur une nouvelle methode d'approximation pour les equations differentielles de tous les ordres*, 1769, p. 193.

5. *Sur les Equations aux differences partielles*, 1770, p. 108, Hist. p. 69.

6. *Sur les Equations differentielles* 1770, p. 191, Hist. p. 69.

7. *Addition aux Memoires de M. de Condorcet*, p. 108, 151, and 171, of the volume for 1770, p. 615.

8. *Sur la determination des fonctions arbitraires qui entrent dans les integrales des Equations aux differences partielles*, 1771, p. 49.

9. *Reflexions sur les methodes d'approximation, connues jusqu'ici pour les Equations differentielles.* Id. p. 281.

10. *Theoremes sur les quadratures.* Id. p. 693.

11. *Recherches de Calcul Integral.* 1772, p. 1.

12. *Memoire sur le Calcul des Probabilites*, 1781, p. 707.

13. *Suite du Memoire sur le Calcul des Probabilites*, 3d part, 1782, p. 674.

14. *Do. do.* 4th part, 1783, p. 539.

15. *Essai sur le Population du Royaume, par* Messrs Du Sejour, le Marquis de Condorcet, et de La Place, 1784.

16. *Suite du Memoire sur le Calcul des Probabilites*, 1784, p. 454.

17. *Suite de l'Essai pour connoitre le population du Royaume, par* Messrs Du Sejour, le Marquis De Condorcet, et M. de la Place, 1784.

18. *Do.* 1785, p. 661.

19. *Do.* 1786, p. 703.

20. *Do.* 1787, p. 601.

21. *Do.* 1788, p. 755. (*o*)

CONDORE. See Pulo Condore.

CONDUCTORS. See Electricity.

CONE. See Conic Sections.

CONFEDERATION of the Rhine, is the name of an act by which several German states separated themselves from the Germanic body, and associated for their mutual defence under the protection of the Emperor of the French. The deed under which these states were united, was signed at Paris on the 12th of July 1806, and in consequence of this, Francis II. formally abdicated the German empire on the 6th of August 1806.

The following Table contains the states which formed the Confederation at its commencement, with their extent, population, military and political state.

Confederation of the Rhine.

Confederation of the Rhine.

Names of the Kingdoms and Principalities.	Extent in square miles.	Population.	Military State.	Revenue in Florins.
Kingdom of Bavaria, ...	1750	3,290,000	65,000	20,000,000
Do. Wurtemburg, ...	320	1,160,000	18,000	8,000,000
States of the Prince Primate, ...	45	195,000	1,000	1,500,000
Grand Duchy of Baden, ...	265	817,000	10,000	6,000,000
Do. of Cleves and Berg, ...	201	610,000	8,000	2,300,000
Do. of Hesse Darmstadt, ...	196	486,000	9,000	2,500,000
Duchy of Nassau-Usingen, } Do. of Weilbourg, }	95	260,000	6,000	1,900,000
Principality of Hohenzollern-Hechingen, and Siegmaringen, * . . } .	20	50,000	500	300,000
Do. of Salm-Salm, ...	21	36,000 }	400 }	300,000
Do. of Kirbourg, ...	11	18,000 }		
Do. of Isembourg, ...	14	42,000	500	200,000
Do. of Aremberg, ...	50	59,000	400	400,000
Do. of Lichtenstein, ...	2	6,500		20,000
Adjoining states, ...	(102)	(290,000)		(1,250,000)
Principality of Leyen, ...	3	500		130,000
Total, ...	2993	7,034,500	118,800	43,550,000

The following Table contains a list of the states that have recently acceded to the Confederation of the Rhine.

Names of the Kingdoms and Principalities.	Extent in square miles.	Population.	Military State.	Revenue in Florins.
Kingdom of Saxony, ...	750	2,050,000	50,000	13,000,000
Do. Westphalia, ...	710	1,913,400	30,000	12,000,000
Mecklenbourg, Schwerin, †	226	328,636	1,900	1,000,000
Oldenbourg, ...	100	160,000	800	50,000
Mecklenbourg Strelitz, ...	48	70,000	400	300,000
Grand Duchy of Wurtzbourg, ...	96	265,000	6,000	2,500,000
Do. of Saxe-Weimar, ...	37	112,000	800	1,200,000
Duchy of Saxe-Gotha, ...	54	179,000	2,400	1,350,000
Do. Saxe Meiningen, ...	20	50,000	400	450,000
Do. Saxe Cobourg, ...	18	60,000	400	350,000
Do. Saxe Hildbourghausen, ...	12	34,000	200	200,000
Principality of Anhalt Dessau, ...	18	54,000 }		
Do. Bernbourg, ...	17	38,000 }	600	600,000
Do. Cothen, ...	15	32,500 }		
Do. Schwartzbourg, ...	24	55,000 }		350,000
Do. Sunderhausen, ...		}	400	250,000
Do. Rudelstadt, ...	20	56,000 }		200,000
Do. Waldeck, ...	22	48,000	500	400,000
Do. Reuss, ...	24	80,000	400	420,000
Do. Lippe, ...	32	90,000	300	340,000
The three Hanseatic towns (uncertain)	15	210,000	600	1,800,000
Total, ...	8184	5,326,900	93,000	35,610,000

The fate of the following states has not yet been decided.

The countries of Hanover and Lunenburg; of Tecklenbourg, Lingen, Marck, and part of Munster in Westphalia; the provinces of Schmalkalden, Corvey, and Beilstein; the compte of Hainau, and the principalities of Baireuth, Nassau-Dietz-Siegen, Dillenbourg, Fulda, Erfurth with its compte, and Gleichen. The square surface of these states is about 778 miles, their population about 1,600,000, and their revenue 7,995,000.

In the *Almanach du Commerce de Paris*, by Tynna,

* These two principalities are separated in some more recent accounts of the Confederation of the Rhine, and stand thus:—

	Extent in sq. Miles.	*Population.*	*Military State.*	*Revenue.*
Hohenzollern Hechingen, ...	5	13,000	97	50,000 Risdales.
Hohenzollern Siegmaringen, ...	6	14,500	193	66,000 Do.

† The three principalities of Mecklenbourg, Schwerin, Oldenbourg, and Mecklenbourg Strelitz, are inserted on the authority of Reichard, in his *Itineraire de Poche de l'Allemagne et de la Suisse*, published at Paris in 1809; but M. Ockhart in his *Apperçu de l'etat actuel de l'Allemagne*, ranks these principalities among the states that do not belong to the Rhenish Confederation.

Confederation of the Rhine.

for 1811, the Grand Duchy of Warsaw, and the Grand Duchy of Frankfort, are numbered among the states which compose the Confederation of the Rhine. The population of the Grand Duchy of Warsaw is 2,200,000, and its principal towns are Warsaw, Posen, and Bromberg. By the treaty of peace with Austria, in 1809, Western Gallicia, an arrondissement round Cracow, the circle of Zamosc in Eastern Gallicia, and Wielicza, &c. were added to this Grand Duchy.

The Grand Duchy of Francfort is divided into four prefectures, of which the chief towns are, Francfort on the Mayne, Hanau, Aschaffenbourg, and Fulda. Charles Baron D'Alberg, Archbishop of Ratisbon, and Prince Primate of the Confederation of the Rhine, is Grand Duke of Francfort. The population and superficial extent, and the military and financial state of this district, have not yet been ascertained.

The following are the original stipulations which were entered into by the confederated states.

Art. I. The confederated states are for ever separated from the Germanic body, and united by a particular confederation, under the designation of the "Confederated States of the Rhine."

II. Renounce the laws; and,

III. The titles of the empire.

IV. The elector arch-chancellor takes the title of prince primate and most eminent highness, which title shall convey no prerogative derogatory to the entire sovereignty which every one of the contracting parties shall enjoy.

V. The elector of Baden, duke of Berg, and landgrave of Hesse Darmstadt, take the title of grand dukes; the chief of the house of Nassau that of duke; and the count of Leyen that of prince.

VI. The affairs of the confederation shall be discussed in a congress at Frankfort on the Mayne; divided into two colleges, that of the kings and that of the princes.

VII. The members of the league must be independent of every foreign power. They cannot enter into any other service but that of the states of the confederation and its allies. Those who have been in the service of a foreign power, and choose to continue in the same, must abdicate their principality in favour of one of their children.

VIII. Should any prince be disposed to alienate the whole or any part of his sovereignty, he can only do it in favour of a confederate.

IX. All disputes are settled in the assembly at Frankfort, where,

X. The prince primate presides. But if the two colleges deliberate separately, he presides in the college of kings, and the duke of Nassau in the college of princes.

XI. The fundamental statute is to be framed by the prince primate.

XII. The French emperor is protector of the confederation, and names the successor of the prince primate.

XIII. to XXI. Enumerate the cessions made by members of the league: thus, Nassau cedes to Berg the town of Deuss and its territory; Bavaria acquires the imperial city of Nuremberg and its territory: and,

XXII. The prince primate receives Frankfort on the Mayne, and its territory, as his property.

XXIII. and XXIV. Enumerate the lordships over which the members of the confederation exercise the rights of sovereignty.

XXV. They also enjoy the sovereignty over the imperial knightdoms included within their boundaries.

XXVI. The rights of sovereignty consist in legislation, administration of justice, military conscription or recruiting, and levying taxes.

Conferva, Confession.

XXVII. Regulates the patrimonial or private property of the subordinate princes and counts. Their domains cannot be sold or given to any prince out of the confederation, without being first offered to the prince under whose sovereignty they are situated.

XXVIII. These subordinate princes and counts preserve the privilege of being tried by their peers. Their fortune cannot be confiscated, but their revenues may be sequestrated during the life-time of the criminal.

XXIX. and XXX. Regulate the payment of debts.

XXXI. The subordinate princes or counts may take up their residence where they choose, and draw their rents or capitals without any reserve.

XXXII. Public functionaries not retained by the new sovereign, receive a pension proportionate to the situation they held.

XXXIII. The same takes place with respect to religious orders losing their income.

XXXIV. The confederates renounce all reciprocal claims, except the eventual right of succession.

XXXV. Between the Emperor of France and the confederated states there shall be federatively and individually an alliance, by virtue of which every continental war in which either is engaged shall be common to all.

XXXVI. In the event of any power making preparations for war, the contracting parties, in order to prevent surprise, shall, upon the requisition of the minister of one of them at the assembly of the league, arm likewise. And as the contingent of the allies is subdivided into four parts, the assembly shall decide how many are to be called into activity. The armament, however, shall only take place upon the summons of the French emperor to each of the confederates.

XXXVII. The king of Bavaria binds himself to fortify Augsburgh and Lindau, and to form and maintain artillery and baking establishments in the said places.

XXXVIII. The contingent of each confederate is: France 200,000 men, Bavaria 30,000, Wirtemberg 12,000, Baden 8000, Berg 5000, Darmstadt 4000, Nassau, Hohenzollern, and others, 4000, &c.

XXXIX. Admits of the accession of other German princes; and,

XL. as the concluding article, stipulates the exchange of the ratifications. (*o*)

CONFEDERATION, Helvetic. See the article Switzerland.

CONFERVA, a genus of plants of the class Cryptogamia, and order Algæ. See Cryptogamia.

CONFESSION of Faith, simply considered, is the same with creed, and signifies a summary of the principal articles of belief adopted by any individual or society. In its more common acceptation, it is restricted to the summaries of doctrine published by particular *Christian* churches; with the view of preventing their religious sentiments from being misunderstood or misrepresented; or by requiring subscription to them, of securing uniformity of opinion among those who join their communion. Of the lawfulness or expediency of confessions for the latter of these purposes, it is not our intention to treat in the present article; but shall content ourselves with giving a short account of the most distinguished formulas of Christian faith, both ancient and modern; noticing as we go along the chief points in which they agree or differ.

Irenæus, A. D. 180.

Except a single sentence in one of the Ignatian Epistles, which relates exclusively to the *reality* of Christ's personality and sufferings in opposition to the Docetæ,

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the earliest document of this kind is to be found in the writings of Irenæus, who flourished towards the end of the second century of the Christian æra. In his treatise against heresies, (lib. i. cap. 2.) this father affirms, that "the faith of the church planted throughout the whole world," consisted in the belief of "one God, the Father Almighty, Maker of heaven and earth and sea, and all that are in them; and one Christ Jesus, the Son of God, who became incarnate for our salvation; and one Holy Spirit, who foretold through the prophets, the dispensations and advents, and the generation by the virgin, and the passion, and the resurrection from the dead, and the ascension in the flesh into heaven, of Christ Jesus our beloved Lord, and his appearing from heaven in the glory of the Father, to unite together all things under one head, and to raise every individual of the human race; that unto Christ Jesus, our Lord and *God*, and Saviour and King, every knee may bow and every tongue confess: that he may pronounce just sentence upon all."

Tertullian, A. D. 200.

In various parts of Tertullian's writings similar statements occur, which it is unnecessary particularly to quote. We shall only remark, that in one of them, the miraculous conception of Christ by the power of the Holy Ghost is distinctly mentioned; that in another, he declares it to have been the uniform doctrine from the beginning of the gospel, that Christ was born of the virgin, both man and God, *ex eâ natum hominem et Deum;* and that in each of these, faith in the Father, Son, and Spirit, is recognised as essential to Christianity. The following passage we cite, for the purpose of marking its coincidence with the Apostles' Creed, to which we shall have occasion soon to advert. "This," says he, "is the sole, immoveable, irreformable rule of faith, viz. to believe in the only God Almighty, maker of the world, and his son Jesus Christ, born of the virgin Mary, crucified under Pontius Pilate, the third day raised from the dead, received into heaven, now sitting at the right hand of the Father, about to come and judge the quick and the dead, by the resurrection also of the flesh." Tertullian *De Virg. vel.*

Origen, 320.

The summaries contained in the works of Origen, nearly resemble the preceding; any difference between them being easily accounted for, from the tenets of the particular heresies against which they were directed. In his Commentary on John's Gospel he thus writes: "We believe that there is one God, who created all things, and framed and made all things to exist out of nothing: We must also believe in the Lord Jesus Christ, and in all the truth concerning his Deity and humanity; and we must likewise believe in the Holy Spirit, and that, being free agents, we shall be punished for the things in which we sin, and rewarded for those in which we do well."

According to Cyprian, the formula, to which assent was required from adults at their baptism, was in these terms: "Dost thou believe in God the Father, Christ the Son, the Holy Spirit, the remission of sins, and eternal life, through the holy church?" This was called by him *Symboli Lex*, the Law of the Creed; and by Novation, *Regula Veritatis*, the Rule of Truth.

Apostles' creed.

From these and similar sources, the different clauses of what is commonly called the Apostles' Creed appear to have sprung. For, though it was long believed to be the composition of the apostles, its claims to such an inspired origin are now universally rejected. Of its great antiquity, however, there can be no doubt; the whole of it, as it stands in the English liturgy, having been generally received as an authoritative confession in the fourth century. Towards the end of that century, Rufinus wrote a commentary on it, which is still extant, in which he acknowledges, that the clause respecting Christ's descent into hell was not admitted into the creeds either of the Western or the Eastern churches; and that the epithet "catholic," was not at that time applied in it to the church. Its great simplicity and conciseness, besides, prove it to have been considerably earlier than the council of Nice, when the heretical speculations of various sects led the defenders of the orthodox faith, to fence the interests of religion with more complicated and cumbrous barriers.

Oriental.

Roman Confession.

The Roman or Western Confession, previous to the fourth century, seems to have been the same with that formerly quoted from Tertullian, with the addition of the articles from the Baptismal Creed, concerning the Holy Spirit, remission of sins, and the church. But that of the Oriental churches, in consequence probably of that philosophising spirit, which most unhappily induced many of their divines to attempt the explanation of subjects altogether beyond the reach of human comprehension, employed various expressions with regard to the divinity and filiation of Christ, which appear to have been for some time peculiar to itself, but which were afterwards adopted in substance by the Nicene fathers.

Nicene, A. D. 325.

In the celebrated council at Nice, in which Arianism was not only condemned but proscribed, the confession established as the universal standard of truth and orthodoxy runs thus: "We believe in one God, Father Almighty, Creator of heaven and earth, and of all things visible and invisible; and in one Lord Jesus, the only begotten Son of God, begotten of the Father, or essence of the Father, before all ages, God of God, Light of Light, true God of the true God, begotten not made, consubstantial or coessential (ὁμοουσιος) with the Father; by whom all things were made; who for us men, and for our salvation, descended from heaven, and became incarnate by the Holy Spirit, of the virgin Mary; and was made man, was crucified for us under Pontius Pilate, suffered, and was buried; and rose again the third day according to the Scriptures, and ascended into heaven, and sits at the right hand of the Father, and will come again with glory to judge the quick and the dead, of whose kingdom there will be no end: And in the Holy Spirit who spake by the prophets: And in one holy, universal, and apostolical church. I confess one baptism for the remission of sins. I expect the resurrection of the dead, and the life of the world to come."

Arian.

It were endless to specify the particular shades of difference by which the Arian confessions, (the number of which amounted nearly to twenty in the space of a very few years), were distinguished from each other. Suffice it to say, that while they agreed generally in substance, especially in rejecting the Nicene term ὁμοουσιος, as applied to the Son, their variations of expression concerning the nature of his subordination to the Father, were so astonishingly minute, as almost to bid defiance to any attempt which might be made, at this distance of time, to determine in what their real and essential differences consisted.

Constantinopolitan, A. D. 381.

Macedonius having denied not only the divinity but the personality of the Holy Spirit, maintaining that he is only a *divine energy* diffused throughout the universe, a general council was called at Constantinople, A. D. 381, in order to crush this rising heresy. The confession promulgated on this occasion, and which "gave the finishing touch to what the Council of Nice had left imperfect, and fixed in a full and determinate manner the doctrine of the Trinity, as it is still received among the generality of Christians," exactly coincides with the

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Nicene confession, except in the article respecting the Spirit, which it thus extends,—" And in the Holy Spirit, the Lord, and Giver of life, who proceeds from the Father and the Son, who is adored and glorified together with the Father and the Son."

Athanasian Creed.

Subsequent to this, and probably towards the middle of the 5th century, the creed which bears the name of Athanasius, appears to have been composed. That it was not the work of this distinguished opposer of Arianism, is established by the most satisfactory evidence. No traces of it are to be found in any of his writings, though they relate chiefly to the very subject of which it is an exposition; and so far from its being ascribed to him, not the least notice is taken of it, by any of his contemporaries. Its language, besides, concerning the Spirit, is so similar to that of the Council of Constantinople, but still more precise and explicit, that there can be no doubt of its having been written posterior to the time of that assembly. Yet Athanasius died in the year 373. Accordingly, it has been, with great probability of truth, attributed, particularly by Dr Waterland, to Hilary, Bishop of Arles, who is said by one of his biographers, to have composed an *Exposition* of the Creed; a title which certainly is more appropriate and characteristic of it, than that of Creed simply, by which it is now so universally known. Its contents we need not mention, as it is to be found in almost every copy of the English liturgy; and, indeed, is frequently used in the episcopal service. We shall only notice farther, that its damnatory clauses have long been the subject of just regret; and that definite and minute as its statements are, it has done nothing whatever to settle the controversies which have been agitated on the subject of the Trinity.

Before leaving the *ancient* formulas of Christian doctrine, it may be stated, that both in the Council of Ephesus against the Nestorians, held A. D. 431, and in that of Chalcedon against the Eutychians in 451, it was solemnly declared and decreed, that " Christ was *one* divine person, in whom two natures, the human and the divine, were most closely united, but without being mixed or confounded together."

Roman Catholic. A. D. 1553.

Amid the variance and opposition of council to council and pope to pope, which prevailed for centuries in the Romish church, it would be no easy task to ascertain the real articles of its confession. The decrees of the council of Trent, however, together with the creed of Pope Pius IV. are now commonly understood to be the authoritative standards of its faith and worship. These, besides recognising the authority of the apostles' and the Nicene creeds, embrace a multitude of dogmas which it is unnecessary particularly to specify, relating to traditions, the sacraments of baptism, confirmation, eucharist, penance, extreme unction, order, and matrimony, transubstantiation, the sacrifice of the mass, worshipping of images, purgatory, indulgencies, &c. &c.

Greek Church.

The Greek church has no public or established confession; but its creed, so far as can be gathered from its authorised catechisms, admits the doctrines of the Nicene and Athanasian creeds, with the exception of the article in each concerning the procession of the Holy Spirit, which it affirms to be " from the Father only, and not from the Father and the Son." It disowns the supremacy and infallibility of the pope, purgatory by *fire, graven* images, and the restriction of the sacrament to one kind; but acknowledges the *seven* sacraments of the Catholics, the *use* of pictures, invocation of saints, transubstantiation, and masses and prayers for the dead.

Though the Romish church early appropriated to itself the exclusive title of catholic, or universal, and though, for many centuries, its unscriptural tenets pervaded the far greater part of Europe, not only were there always some individuals who adhered to the doctrines of genuine Christianity, but, long before the Protestant reformation, there appear to have been whole congregations who maintained, in considerable purity, the substance of the faith contained in Scripture. Such were the churches of the Waldenses in the vallies of Piedmont, whose confession, of so early a date as the beginning of the 12th century, is still preserved. It consists of 14 articles, in which the authority of the apostle's creed, and of the canonical books of Scripture alone, and the doctrines of the Trinity, the fall, original sin, the atonement of Christ, and free unmerited salvation by him as the only mediator, are distinctly asserted; and the popish tenets of human tradition, purgatory, seven sacraments, invocation of saints, mass, and other " antichristian inventions," are declared to be " an abomination."

Waldenses, A. D. 1120.

Augsburg, 1530.

The *first* Protestant confession was that presented in 1530, to the diet of Augsburg, by the suggestion, and under the direction, of John, Elector of Saxony. This wise and prudent prince, with the view of having the principal grounds on which the Protestants had separated from the Romish communion, distinctly submitted to that assembly, intrusted the duty of preparing a summary of them to the divines of Wittemberg. Nor was that task a difficult one; for the reformed doctrines had already been digested into 17 articles, which had been proposed at the conferences both at Sultzbach and Smalcald, as the confession of faith to be adopted by the Protestant confederates. These, accordingly, were delivered to the elector by Luther, and served as the basis of the celebrated Augsburg confession, written " by the elegant and accurate pen of Melancthon;" a work, which has been admired by many, even of its enemies, for its perspicuity, piety, and erudition. It contains 28 chapters, the leading topics of which are, the true and essential divinity of Christ; his substitution and vicarious sacrifice; original sin; human inability; the necessity, freedom, and efficacy of divine grace; consubstantiation, and particularly justification by faith, to establish the truth and importance of which was one of its chief objects. The last seven articles condemn and confute the popish tenets of communion in one kind, clerical celibacy, private masses, auricular confession, legendary traditions, monastic vows, and the exorbitant power of the church. This is the universal standard of orthodox doctrine among those who profess to be Lutherans, on which no authoritative alteration has ever been made.

Basil, 1534

The confession of Basil, originally presented like the preceding to the diet of Augsburg, but not published till 1534, consists of only 12 articles, which, in every essential point, agree with those of the Augsburg confession, except that it rejects the doctrine of consubstantiation, affirming that Christ is only spiritually present in the Lord's supper, *sacramentaliter nimirum, et per memorationem fidei;* and that it asserts the doctrine of predestination and infant baptism. But the more detailed creed of the whole Swiss Protestant churches, is contained in the former and latter Helvetic confessions. The first was drawn up in 1536, by Bullinger, Myconius and Grynæus, in behalf of the churches of Helvetia, and presented to an assembly of divines at Wittemberg, by whom it was cordially approved. But being deemed too concise, a second was prepared in 1566, by the pastors of Zurich, which was subscribed not only by all the Swiss Protestants, but by the churches of Geneva and Savoy, and by many of those in Hunga-

Helvetic, 1536.

1566.

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ry and Poland. They fully harmonise with each other, with only this difference, that the doctrine of predestination, and an approbation of the observance of such religious festivals as the nativity, &c. are to be found in the latter confession only.

Bohemic, 1535, The Bohemic confession was compiled from various ancient confessions of the Waldenses who had settled in Bohemia, and approved of by Luther and Melancthon in 1532; but it was not published till 1535, when it was presented by the barons and other nobles to king Ferdinand. It extends to 20 articles, similar to those of the Waldensian confession, with the addition of others on the divinity of Christ, justification by faith in him, "without any human help or merit," predestination, and the absolute necessity of sanctification and good works.

Saxon, 1551. The confession of the Saxon churches was composed in 1551 by Melancthon, at the desire of the pastors of Saxony and Misnia met in assembly at Wittemberg, in order to be presented to the Council of Trent. It is contained in twenty-two articles: and whilst, like that of Augsburg, it is silent on the subject of predestination, it lays equal stress on the doctrine of justification by faith, and has a separate article entitled "Rewards," in which the doctrine of human merit, particularly as connected with future blessedness, is condemned and refuted.

English, 1553. The first draught of the English confession was prepared by Archbishop Cranmer in 1551, with the assistance of Bishop Ridley; and after being revised by Knox and Harley, and others of the Scotish reformers, corrected by the English bishops, and approved by convocation, it was published both in Latin and English, in the year 1553. Its articles were at first 42 in number, but on being revised in 1562, they were reduced to *thirty-nine,* and then published in Latin only; no authentic English copy of them having been edited till

1571. 1571, when they were again revised by the convocation, and authoritatively published in their present form. They are so generally known, being inserted in most of the Common Prayer Books, that any statement of the doctrines which they contain is quite unnecessary here. We shall only observe, with regard to their Calvinistic complexion, a subject which has, of late years, been agitated with uncommon keenness and ability, that the English delegates at the Synod of Dort certainly believed them to be Calvinistic, otherwise it can scarcely be supposed that they would have gone along with the doctrinal sentiments of that assembly, particularly on the topic of *unconditional* election; and that it is generally understood, that all who are unconnected with the Church of England have no hesitation in numbering the 39 articles among Calvinistic confessions.

French, 1559. The confession of the Reformed Gallican churches was prepared by order of a synod at Paris in 1559; and presented to Charles IX. in 1561, by the celebrated Beza, in a conference with that monarch at Poissy. It was published for the first time in 1566, with a preface by the French clergy, to the pastors of all Protestant churches; and afterwards in 1571, it was solemnly ratified and subscribed in the national synod of Rochelle. It is extended to forty articles; but they are in general concise, and embrace the usual topics of the other Protestant confessions, including the doctrines of election, and justification by faith only.

Scotish, 1560. The Protestants in Scotland having presented a petition to parliament in 1560, requesting the public condemnation of popery, and the legal acknowledgment of the reformed doctrine and worship, they were required to draw up a summary of the doctrines which they could prove to be consonant with scripture, and which they were anxious to have established. The ministers on whom this duty was devolved, being well acquainted with the subject, prepared the required summary in the course of four days, and laid it before parliament, when, after having been read first before the Lords of the Articles, and afterwards twice, (the second time article by article) before the whole parliament, it received their sanction as the established system of belief and worship. It consists of twenty-five articles, and coincides with all the other Protestant confessions which affirm the doctrine of election, and reject that of consubstantiation; for though it is not so explicit as some of them respecting the *unconditional* nature of election, yet a distinct recognition of this doctrine pervades the whole of it; and though it has no separate article on justification, it no less distinctly recognises this fundamental principle of the Protestant faith.

The tenets of Arminius having obtained considerable prevalence in Holland towards the beginning of the 1618-19. 17th century, the Calvinists, or Gomarists as they were then called, appealed to a national synod which was convened at Dort in 1618, by order of the States-General; and attended by ecclesiastical deputies from England, Switzerland, Bremen, Hesse, and the Palatinate, besides the clerical and lay representatives of the reformed churches in the United Provinces. The canons of this synod, contained in five chapters, relate to what are commonly called the *five points,* viz. particular and unconditional election; particular redemption, or the limitation of the saving effects of Christ's death to the elect only; the total corruption of human nature, and the total moral inability of man in his fallen state; the irresistibility of divine grace; and the final perseverance of the saints; all of which are declared to be the true and the only doctrines of scripture.

The only other confession of which we shall take notice, is that of the Westminster assembly, which met in Westminster Assembly, 1643. 1643, and at which five ministers and three elders as commissioners from the General Assembly of the Church of Scotland attended, agreeably to engagements between the convention of estates here, and both houses of parliament in England. This confession is contained in thirty-three chapters, and in every point of doctrine exactly accords with the sentiments of the Synod of Dort. It was approved and adopted by the General Assembly in 1647; and two years after, ratified by act of parliament, as "the public and avowed confession of the Church of Scotland." By act of parliament 1690, 1690. it was again declared to be the national standard of faith in Scotland; and subscription to it as "the confession of his faith," specially required of every person who shall be admitted "a minister or preacher within this church." Subscription to it was also enjoined by the act of union 1707, on all "professors, principals, regents, masters, and others bearing office," in any of the Scottish universities.

On the subject of the preceding article, see *Eusebius;* Mosheim's *Ch. History;* King's *Hist. of the Apostles' Creed;* Waterland's *Critical Hist. of the Athanasian Creed;* Rycaut's *Greek Church;* Morland's *Hist. of the Churches of Piedmont;* the English *Harmony of Confessions;* Corpus et Syntagma *Confessionum;* Kœcheri *Biblioth. Theolog. Symbolicæ;* Buddæi *Isagog. Historico-theolog.;* and Adam's *Religious World Displayed.* (*d*)

Confucius.

CONFUCIUS, or KONG-FOO-TSE, the celebrated Chinese philosopher, was born about 550 years before the

Confucius. Christian æra, in the kingdom of Loo, now the province of Shan-tong, in the reign of Lin-vang, the twenty-third emperor of the dynasty of Tcheoo. By his mother's side, whose name was Shing, he was descended from the noble family of Yen; and his father Tcho-leang-hee numbered among his progenitors the Emperor Tii, of the dynasty of Shang. When he was only three years of age, he was left, by the death of his father, with no other inheritance than those honours of descent; and for no part of his future eminence, was he indebted to the wealth or grandeur of his ancestors. He gave early indications of those exalted talents, by which he was afterwards so much distinguished; and the most marvellous accounts of his premature attainments are minutely detailed by the Chinese historians. Even in infancy, he seemed to have acquired the maturity of reason and the perfect use of all his faculties. He took no pleasure in the amusements of childhood; but was remarkable, almost from his birth, for the gravity of his deportment. He was particularly celebrated for extraordinary piety; and never partook of any kind of nourishment, till he had first prostrated himself on the ground, and made an offering of the food to the supreme Lord of heaven. After the death of his grandfather, a most holy man of those times, whom he had studied to imitate in all things, he put himself under the tuition of an eminent sage, named Tchemsée; and, at fifteen years of age, devoted himself to the perusal of the ancient Chinese books, especially the writings of the royal legislators Yao and Shun. At the age of nineteen, he entered into the married state; and, contrary to the custom of his country, contented himself with one wife, whom he divorced very soon after marriage, that he might be completely free from every incumbrance and connection, which might fetter him in the propagation of his tenets. He had one son named Pe-yoo, who died in middle age, leaving also one son, named Tsoo-tse, who inherited the virtues of his grandfather, and afterwards attained the highest offices in the state.

At the age of twenty-three years, Confucius, having acquired a profound knowledge of the ancient history and laws of the empire, began to attempt a general reformation of manners among his countrymen. In opposition to the boundless luxury and inordinate love of pleasure which everywhere prevailed, and which threatened the utter ruin of the several kingdoms which then composed the empire of China, he taught a system of the strictest morality, and enforced his doctrines by the purity of his own example. By his extraordinary knowledge and amiable virtues, he speedily acquired the most extensive celebrity, and was frequently invested with the highest offices in the magistracy, which he sometimes accepted, when he conceived that they might be made subservient to his plans of reformation; but which he always resigned, whenever he was unable to exercise them with any beneficial effect. As his success, however, did not correspond with his expectations and endeavours, he at length renounced all his dignities in his native country, and went to seek in other parts of the empire a more favourable reception to his precepts. But, in the 55th year of his age, he returned to his native country, the kingdom of Loo, where he was instantly invested with one of the principal offices in the government; and where he is said, in the short space of three months, to have effected, by his counsels and good example, an entire reformation of manners, both among the higher and lower orders of the subjects. The prince put himself and his court under the direction of the philosopher; and the whole kingdom had the appearance of a well-regulated family. The prosperous state of the country, in consequence of these political and moral improvements, excited the jealousy of the neighbouring princes, and filled them with apprehensions, that its growing power might soon become more formidable than was consistent with their security. The king of Tsi, in particular, held frequent consultations with his nobles upon the subject, and at length devised the following scheme for defeating the enlightened measures of Confucius. Upon pretence of sending a friendly embassy, he presented to the prince of Loo and his grandees, a number of the most beautiful young women, who had been carefully instructed in the arts of dancing, singing, and all those other accomplishments which so powerfully enslave the hearts, and enervate the minds of men. In spite of all the remonstrances of Confucius, the fair strangers experienced a welcome reception from the prince of Loo and his principal officers at court; and all the affairs of government were speedily banished from their thoughts by the succession of feasts and diversions into which they were plunged, without a moment's intermission, by the fascinations of their new favourites. The sovereign, deaf to every sound but the voice of pleasure, could not endure to be addressed on points of public concern; and even refused at length to admit his most faithful ministers to his presence. The philosopher attempted in vain to stem this torrent of dissipation which inundated the court, and which sufficiently proved the slight impression which his instructions had made. Finding all his struggles utterly ineffectual, he resolved to resign his employments, and to become once more a voluntary exile from his degenerate country.

He passed in his progress through the kingdoms of Tchi, Goo-shi, and Tsoo, without receiving the slightest encouragement to take up his residence in any of their cities. The austere integrity of his politics, and the strict simplicity of his manners, rendered him everywhere rather an object of dread; and he was generally regarded by the leading men of every province, both as a dangerous associate, who would speedily undermine their influence by his superior talents, and also as a troublesome monitor, who would perpetually disturb their pleasures by his virtuous reproofs. He often experienced the most contemptuous treatment from the more licentious nobles; and conspiracies even were in some instances formed against his life. By totally neglecting his personal interests, he found himself reduced at length to a state of extreme indigence, and was compelled to resume his original office of a private instructor. Declining the invitation of certain sages of his time, to withdraw from the world, and lead the life of a hermit, he resolved to devote himself to the improvement of the lower classes of the people. Ceasing, therefore, to address himself to the inhabitants of palaces, and the attendants of courts, he employed the remaining part of his life in making the most distant and fatiguing journies throughout the Chinese empire, instructing every where persons of every rank, who were willing to listen to his precepts. And as in all his discourses, he was continually producing the maxims and example of the ancient Chinese worthies, Yao, Shun, Yu, Tching-tang, and Ven-vang, he began to be regarded as in a manner the representative of these imperial sages, and at length attracted around him a considerable number of followers.

Besides his general admirers, he is said to have had above three thousand disciples, who were more particularly attached to his person and principles. These he distributed into four classes; the *first* consisting of those who devoted themselves to the cultivation of their minds by frequent meditation, and to the improvement of their hearts by the sentiments of virtue; the *second*, of those who addicted themselves to the study of just reasoning, and to the practice of eloquent composition; the *third*, of those who employed themselves in investigating the principles of good government, and instructing the mandarins in their duties; and the *fourth*, of those who exercised their powers in communicating to the people, in a clear and polished style, the precepts of practical morality. All these disciples were understood as engaged, in their respective stations and pursuits, in cultivating and extending the philosophy of their master; and five hundred of his pupils are said to have attained, during his life, the highest offices of government in the different kingdoms of China. Seventy-two of that number were selected as a kind of honorary class, who were distinguished by the superiority of their attainments; and again, ten out of these are celebrated as the most perfect, who had reached the full comprehension of the philosopher's system. One of these, particularly, named Yen-yuen, was the most favoured of his pupils; and his death, at the early age of thirty years, is said to have afflicted him with more poignant and lasting grief, than any other calamitous occurrence in the course of his protracted and eventful life.

Confucius, during the latter part of his life, sent 600 of his disciples through the different provinces of China, to disseminate his tenets, and reform the manners of the people; and is said to have even formed the design of propagating his doctrines in foreign countries. His reputation and success, however, while he was alive, appear, even from the Chinese accounts, to have been extremely limited and variable, and to have depended more upon the favour of the individual princes, by whom he was occasionally patronized, than upon any real attachment to his principles among his contemporaries. When he was invited to the palace, and honoured with the notice of any of the petty sovereigns in the empire, it became the fashion of the court, and, in a manner the law of the kingdom, to admire his instructions, and extol his character. But, upon the decease of his royal patrons, or the decay of their attachment, he frequently experienced a total revolution in his affairs, and found his precepts despised, and his person in a manner proscribed in those very places, where he had been revered as the fountain of all wisdom, and the example of every virtue. The courtiers, on such occasions, who had envied his influence, and disliked his restraints, made him the subject of their songs and satires; and the changeable multitude, following the example of their superiors, assailed him openly with the most insolent revilings. He appears, indeed, before his death, to have lost all his influence, and to have retained the affections only of a few disciples, who were more immediately attached to his person. This is sufficiently confirmed by the circumstances related of his latter days, and the expressions ascribed to him on his death-bed by his most ardent admirers. According to their united testimony, he spent the three concluding years of his life in retirement and sorrow. A short time before his last illness, he told his disciples, with tears in his eyes, that he was overwhelmed with grief, on account of the great disorders which every where prevailed throughout the empire. "The mountain," he added, "is fallen, the high machine is demolished, and all the sages have disappeared;" by which he intimated, that the edifice of perfection, which he had endeavoured to raise, was almost completely overthrown. From this period, he began to languish; and, on the seventh day before his death, again addressed his attendants in similar terms of despondency: "The kings refuse to follow my maxims; and since I am no longer useful on the earth, it is as well that I leave it." He then sunk into a lethargy, which continued for the space of seven days, when he expired in the arms of his disciples, in the 73d year of his age, and about 479 years before the birth of Christ.

No sooner was he dead, than the veneration for his name began to revive; and the prince who then reigned in Loo, whose name was Ngai-kong, upon receiving intelligence of his decease, is said to have burst into tears, exclaiming at the same time, "The Tien is displeased with me, since he has taken away Confucius." His disciples clothed themselves in habits of mourning, and lamented his loss, as they would have done that of a parent. His sepulchre was erected near the city of Kio-feoo, the supposed place of his nativity, upon the banks of the river Loo, where he used to assemble his pupils. His descendants possess the rank of nobility; and he receives throughout the vast empire of China, not indeed divine honours, as some have affirmed, but that secondary species of worship which the Chinese are accustomed to offer to tutelary spirits, and to the manes of their ancestors. In almost every city and village, a plain building or chapel is erected to his memory, called "The house of Confucius," in which is placed a simple tablet, with inscriptions in gilt letters to this effect: "O Confucius, our revered master, let thy spiritual part descend, and be pleased with this tribute of respect, which we now humbly offer thee." Wine, fruits, flowers, and perfumes are placed before the tablet; incense is burned; tapers of sandal-wood lighted; and the same ceremonies observed, as in the honours which are paid to deceased ancestors. These offerings in the temples of Confucius are made chiefly by the literary young men, when they are about to undergo their public examinations; but the memory of the philosopher is held in estimation by all classes of the Chinese, who regard him as, without exception, the most eminent sage, and the wisest legislator that ever appeared, either in their own or in any other nation. His name is interwoven with almost every civil institution or observance in the Chinese empire; and his doctrine is considered as the only foundation of all political wisdom, or moral virtue.

With respect to his personal appearance, he is described by his Chinese biographers, as having been of a tall stature, and a well proportioned form, with an olive complexion, large eyes, a flat nose, a long and black beard, a broad chest, and a sharp strong voice. His countenance was rather disfigured, by a swelling in the middle of his forehead; from this circumstance, he received from his father the sirname of Kieoo, or "little hill;" a designation which he used frequently, in modesty or in jest, to apply to himself, even during the period of his highest renown.

In his moral character, he is represented as having been a pattern of integrity, temperance, and contempt of sublunary wealth; and as having invariably exemplified in his own conduct the precepts of virtue, which he publicly inculcated. He is likewise celebrated on account of the unequalled fortitude and equanimity with which he sustained every reverse of his fame or fortune; and the following instance of his pious composure, in situations of the most imminent danger, is

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frequently cited by his admirers in China. An officer of the army, named Hoan-tee, enraged by the restraints, which the precepts and presence of Confucius imposed upon him and his associates, made a daring assault upon the philosopher in open day with a drawn sabre, but happily failed in his attempt to inflict a mortal blow. The intrepid sage, in the mean time, discovered not the smallest emotion or symptom of dread; and when his terrified followers besought him to hasten from the presence of the brutal mandarin, he is said to have calmly replied in these words: "If the Tien protects us, of which he has just given a sensible proof, what harm can the rage of Hoan-tee do to us, although he be the president of the tribunal of the army?" This bold and undaunted spirit was united, we are told, with the most gentle temper and humble disposition of mind, which frequently led him to disclaim the high praises that were bestowed upon him, and to lament, on the contrary, his numerous deficiencies. His doctrine, he used to say, was not his own, but was derived from the ancient sages, particularly from those wise legislators, Yao and Shun. "There are four things," he frequently said to his more favoured disciples, "which give me continual uneasiness; the first, that I have made so little progress in virtue; the second, that I am not sufficiently eager in the prosecution of my studies; the third, that I am not more devoted to the duties of justice; the fourth, that I am not duly watchful over my own heart and actions." Being informed one day, that he was generally denominated *king*, which, in the Chinese tongue, signifies *wisest*, he replied, "I deserve no such encomium, and I can by no means suffer it. All the good that can be said of me is, that I do my utmost to acquire wisdom and virtue, and that I am not discouraged by the difficulties which I encounter in teaching them to mankind." The following epitome of his character is current among his disciples in China, namely, that he united in himself three things, which appear most incompatible with each other; all the grace of a polite behaviour, with a great deal of gravity; a stern aspect, with a great deal of good nature; and an extraordinary elevation of soul, with a great deal of modesty.

These details of the life and character of Confucius rest entirely upon the authority of the Chinese writers, and may naturally be conceived to partake, in some respects, of their characteristic exaggeration in whatever relates to the honour of their nation. But of the nature of his doctrines, a more impartial judgment may be formed from his own writings, which have been faithfully preserved, and which compose the greatest portion of the classical or canonical books of the Chinese. For a general view of his principal tenets, the reader is referred to the article China in this work, p. 248; and to p. 276, for an account of those sacred books, among which his writings are classed. The productions of his pen, which rank in the first class of the *King*, or canonical books, are, 1. A commentary on the lines of Fo-shee, in which he details a species of divination or fortune-telling, and which forms the principal part of the book Y-king: 2. The whole of the second canonical book, called Shooking, a collection of the earliest historical records of the Chinese nation, of which Confucius professes only to be the editor, but of which he is suspected to have been in reality the author: 3. A book of his maxims, collected by his disciples, and forming part of the canonical book called Lee-kee: 4. The whole of the fifth canonical book, called Tchun-tsieoo, consisting of the annals of his native country, the kingdom of Loo, commencing 722 years before Christ. His other writings, which are arranged in the second class of *King*, or classics, are known under the title of See-shoo, or "the four books" of Confucius, viz. Ta-hio, or sublime science; Tchong-yong, or just medium; Lun-yu, or words and discourses; and Meng-tse, or the book of Mencius, one of his disciples. Of the contents of the three first of these pieces, a slight sketch may be found in Du Halde's History of China, vol. iii. p. 303. of the English translation, published in London in the year 1736; and an English translation of the first, viz. Ta-hio, has been very recently published by the Rev. R. Morrison, Protestant missionary at Canton, in a work entitled *Horæ Sinicæ*. Two other books, considered as the production of this philosopher, are held in great repute, and are more generally perused among the great body of his countrymen, than his writings of a higher class. These are Hiao-king, which treats of filial reverence, or the respect due to parents; and Siao-hio, that is, "the science or school of children," a collection of sentences and examples from various authors. These two pieces have been translated into Latin by Father Noel, one of the earliest missionaries in China, and were printed at Prague in 1711. See Du Halde's *History of China*, vol. iii. p. 293; *Modern Universal History*, vol. viii. p. 104; *General Biographical Dictionary*; Enfield's *History of Philosophy*, vol. ii.; D'Anquetil's *Hist. Universelle*; Le Compte's *Memoirs of China*; Martinii *Historia Sinica*, lib. iv.; Barrow's *Travels in China*; and Morrison's *Horæ Sinicæ*. (*q*)

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CONGELATION. See Cold and Meteorology.

CONGLETON, a small corporate town of England, in the county of Chester, situated on the borders of Staffordshire, on the upper part of the river Dane. The houses are principally situated in one street, and, in general, are remarkably neat and elegant. There are two churches here which are subject to the church of Astbury, a village about two miles distant, where there are two ancient stone monuments, decorated with the insignia of knighthood. This town was formerly celebrated by its manufacture of tagged leather laces, called Congleton points, but the poor are principally employed in a handsome silk mill built upon the Dane; in a manufacture of ribbands, which are sold to the merchants in Coventry, and in a manufacture of gloves and purses. In the neighbourhood of Astbury, there are large lime quarries, and the lime is burnt by coals obtained on purpose from Staffordshire. This limestone, which is of an ash grey colour, is heavier than that of Buxton, and is preferred as a manure by the farmers.

According to the population returns for 1811, the town of Congleton contains,

Inhabited houses	944
Families that occupy them	986
Houses uninhabited	30
Families employed in agriculture	158
Families employed in trades and manufactures	753
Males	2023
Females	2593
Total population in 1811	4616
Do. 1801	3861
Increase	755

CONGO, a kingdom of Africa, bounded on the north by the river Zair, or Congo, which divides it from Loango; on the south by the river Danda, which separates it from Angola; on the east by the kingdoms of Fungo- Boundaries.

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no and Melamba, and the burnt mountains of the sun, (those of crystal, or saltpetre, and silver,) and by the rivers Verbela and Chilandea; and on the west by that part of the Atlantic Ocean called the Ethiopic Sea, or the Sea of Congo. According to this definition of its limits, Congo Proper extends about three degrees from north to south, lying on the coast between 8° and 9° south lat. but widening in its breadth inland with the course of the river Zair, which runs winding above 2° more to the north. Both however in this direction, and still more in that of its length from east to west, its dimensions are very uncertain, no exact observations having been taken of the precise position of those natural boundaries within which it is contained. According to the relation of John Anthony Cavarri de Monte Cuculo, a capuchin missionary, the dominions of the kings of Congo were much extended towards the east and south, before the introduction of the Christian religion; whereas, since that event, many of the remote provinces, in these directions, having been dismembered from it, it was reduced, in consequence, from above 600 leagues in circuit, to less than one half of that extent. Dr Brookes and Mr Walker state it to be 150 miles long, and 372 broad.

Divisions.

Congo is divided into six large provinces, of which the county of Sogni, and the great duchy of Bamba, stretch along the sea coast; the duchy of Lundi, and the marquisate of Pango, are situated towards the north; the marquisate of Pemba is within land, and to the west is the duchy of Batta. These provinces are subdivided into lesser seignories, or lordships. Besides those principal divisions, there are comprehended under the same general denomination several other lesser provinces, most of which are covered with forests or mountains, and inhabited by races of men in a state the most uncultivated and savage.

Rivers.

The principal rivers of this country are the Zair, already mentioned, with the Dando. In the intermediate parts between these are the Lehundo, Doce, Ambrez, Loze, Onzo, and Lutana, with several others of less note. There is, besides, a considerable number of tributary streams of some moment, flowing chiefly into the Zair, such as the Bancaro, the Vambra, the Congo, and the Barbela.

Climate, Seasons, &c.

Congo Proper, being situated within the torrid zone, is liable to excessive heats. These, however, are considerably mitigated by winds and breezes, rains and constant dews, the effect of which is at the same time farther favoured by the greater equality in those latitudes in the length of the days and nights. The summer and the winter, which compose the year of the Congoese, are divided by them into six seasons, which they distinguish by the names *Massanza, Neasu, Ecundi, Quitombo, Quibiso,* and *Quimbangala*. The first four of these comprehend what may be called their summer. At the commencement of this period, which corresponds to our month of October, the rains begin to fall in those countries, and they continue during the two, and sometimes the three next months. The floods which are thus occasioned, are commonly succeeded by a famine, the low lands being overflown by them, and the corn carried off; while, notwithstanding the frequency of such misfortunes, by which it might have been expected that experience would have been gained, and better habits induced, the inveterate sloth of the inhabitants continues such, that due care is seldom taken to make any proper provision against such disasters. Neasu begins about the end of January, when the produce of the lands has arrived at its full height, and wants but a few days of being ripened for harvest. The first crop is no sooner gathered in, than the fields are sown anew, two harvests being commonly obtained here in the course of the year. The third and fourth seasons are frequently (if such an expression may be used) blended together towards the middle of March, when the more gentle rains begin to fall, and continue to do so till the month of May. The principal distinction between these two seasons, or the parts of them, consists in the greater or lesser quantity of rain that falls during their progress. During the rest of the time in which the rains do not prevail, the air is clear and dry, while the clouds, being overcharged with electric matter, burst out occasionally into the most terrible thunders and lightnings, without yielding, though they seem loaded with it, the least drop of rain. These seasons taken together, last till about the beginning, or sometimes till the end of September. The two last seasons, Quibiso and Quimbangala, constitute the short winter of this country, of which the distinguishing features are not frost or snow, which are unknown in these regions, but dry blasting winds that strip the earth of its verdure, and induce a general face of deadness and desolation, till with the return, in the appointed time, of the next massanza, or spring, the vernal bloom is restored. The weather is, during this period, considered by the natives as cold, though to those accustomed to the regions of the northern European climates, it would on the contrary appear rather hot. By another division of time recognised among the Congoese, the year is made to consist of 12 lunar months, beginning, like the year of the Jews, with the month of September. They have also weeks, but consisting of four days only, three of which are appointed for labour, and the fourth for rest or religious exercises.

Mineral productions.

Congo is said by some of those who have visited it, to be very rich in mineral productions. According to Josser, its mountains yield in several places very fine stone for building, which may, moreover, be obtained of an extraordinary magnitude. There are here also even entire mountains of porphyry, of jasper, and of marbles of different colours, which in Italy are known by the name of the marble of Numidia, of Africa, and of Ethiopia. In the same mountains there is found a kind of stone containing beautiful hyacinths diffused over the mass, previously to the separation of which it might be formed into columns of the greatest beauty. Among other articles of rare produce in this department, there are mentioned various stones that appear impregnated with copper and other metals, which receive the finest polish, and are of admirable use in sculpture and engraving. Mines of copper of an excellent quality are very frequent in Congo. It is particularly prevalent in the province of Bemba, near to the city of the same name. In Sogni, it is hardly less abundant; and the copper of that district, being even better than that of Bemba, it is used at Loanda in the fabrication of bracelets and rings, which are in the way of trade transported to Kallabar, Kiodelkey, and other places. Linschoten asserts, that in Bamba there are mines of silver, and some other metals, and that at Lundi there are found mines of crystal and of iron. The last, he says, are the most highly esteemed of the negroes, because of that metal they make their knives, swords, and other arms. It has been imagined by some, that there are immense treasures of precious stones concealed in this country. Dapper seems satisfied, from different assurances which he had received on the subject, that it contains mines of gold, particularly in the

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vicinity of the capital. Carli and Lopez agree with him in opinion as to the existence in the country of such mines; but if the fact actually be so, it would appear, at least, that they have hitherto escaped the keen-sighted avarice, in respect to such objects, of the Europeans who have settled in that quarter; a circumstance for which, indeed, it has been endeavoured, though it may be judged by some rather unsuccessfully, to account.

Soil.

The soil of Congo is naturally very fertile. The principal article of its vegetable produce is rice, which grows here in great abundance, as does also Indian corn, barley, and beans. The Indian wheat grows very strong, and is very well filled. This being ground, is made into bread, or boiled with water into a kind of pap. The other sorts of grain raised here, contribute, in like manner, to the nourishment of the inhabitants; but what, it is said, they chiefly live upon, is a kind of nut like our filberts, which fall to the ground of themselves, and are to be found every where; every nut that so falls producing a new shrub in the succeeding year.

Fruit trees, shrubs, &c.

All the fruit trees common in Asia and in Africa prosper in Congo, and they even succeed there remarkably, attaining to such magnitude, that a single tree may be sufficient for the construction of a great number of houses or of canoes. Vegetation is here so rapid, that, if Lopez may be credited, he has seen a citron tree rising to a considerable height within four days from the time that he had planted it in the state of a seed. Among the fruit trees that are found here, there are mentioned besides, citrons, lemons, bananas, palm-trees; it is even alleged, that in the marshy grounds there grow sugar canes, of which the inhabitants make no use. There is also a kind of pepper, known by the name of malaguette, or manegette, which is an object of commerce with this people. Cassia, tamarinds, and other drugs that are held in esteem, grow here in abundance. It is said that the fruit trees found in these parts have in general been introduced by the Portuguese. Of palm-trees, which are exotic and brought from America, there occur no less than eight sorts, all excellent in their kinds, and which, in almost every part of them, are turned to useful account. The oil obtained from these trees is used instead of butter; with the moss that grows about the trunks, the rich commonly stuff their pillows, and the Giagas apply it to their wounds with good effect. With the leaves, the Moors cover their houses; and they draw from the trees by incision, a pleasant liquor like wine, which, however, turns sour within a few days. From the Congo palm-tree, so called because it thrives better in that country than any of the other sorts, there is obtained a liquor which is reckoned as valuable as the wine that is brought from Europe, though it is rather a kind of milk, sweet and agreeably tart, which will become sour in three or four days, and is so strong that a pint of it will produce intoxication. The fruit of this tree, not unlike a peeled chesnut in colour, taste, and substance, is, as has been remarked, the common food of the poorer class of the people. With the oil that is drawn from it, the natives dress their victuals, but the Europeans only burn it in their lamps. Of the shrubs of this country, may be mentioned the capano, or the fig of hell, from the nut of which is extracted an oil for the lamp, of which use is also made in the composition of ointments and plasters, while the leaves burnt to ashes, afford a good lye, with which the natives wash their bodies. Vines have been brought here from Candia, and they yield excellent grapes twice a-year. The manioc, which is used for making bread, is the same that is employed for the like purpose in Asia and America. The potatoes, and other roots of a like kind, yield a grateful nourishment. Wheat, it is said, is the only kind of vegetable produce that will not prosper here. It pushes forth, indeed, the straw and the ear; the former, we are told, even rising to such a height as to hide a man on horseback, while the latter continues empty, or without a grain in it fit for use. Father Labat, however, having, as he says, observed the same thing in some of the American islands, and having had the curiosity to examine those ears more carefully, found in them a few grains, which, having sowed afresh, they produced very long ears, full of large heavy grain; whence he concludes, that if the like experiment had been tried by the Portuguese in their African settlements, it might have been attended by a similar result. In the lowlands of Congo, the grass grows so high, rank, and thick, as to become one of the most dangerous receptacles for wild beasts, serpents, and venomous insects. Travelling through the country is thus rendered very dangerous, there being in the whole of it but few beaten roads, and the only passage being consequently over vast plains, where hazard is at once encountered from the destructive creatures by which these are frequented, and from the manifold diseases that are produced by the unwholesome dews with which the grass is covered during some part of the day. The flowers of these parts are exceedingly beautiful and numerous, almost every field and grove yielding, in this respect, a much nobler prospect than is presented by the European gardens, even after all the pains bestowed on their cultivation. These flowers are remarkable, not only for the prodigious variety of their colours, but for the vast quantity of heads which grow upon one stalk. The lilies which grow naturally in the fields, vallies, and woods, surpass those cultivated in Europe, not only by their extreme whiteness, but also by a most delightful fragrancy. The tulips that in like manner grow wild, have something surprisingly charming in the variety and combination of their colours, and their flowers grow 10 or 12 upon a stalk, which continue long in full bloom, and diffuse a very reviving and agreeable sweetness. The tuberoses, hyacinths, and other native flowers, are distinguished by similar properties, springing up in vast groupes of 100 or 200 from one root, some of them finely variegated, and all yielding an agreeable smell. The roses, jessamines, and other exotics brought from Europe or America, come up likewise in great perfection, and by due care may be long kept in that state. The fruit trees that have been introduced here, those that have been already mentioned, together with oranges, granates, cedars, and others, thrive, it is said, as well in this as in their native soil.

Wild animals.

The kingdom of Congo, like most other parts of Africa, breeds a prodigious variety of living creatures, both wild and tame. Those of the former sort are particularly numerous. The most remarkable of the animals in this class is the elephant, which is found chiefly in the province of Bamba, a province that abounds with woods, pasture, and plenty of water. They go commonly in troops of 100 or more; and some of them are of such a monstrous size, that the prints of their hoofs are said to measure from four to seven spans in diameter. They delight much in bathing themselves during the heat of the day. Lopez remarks, that they are of very gentle temper, and are much at ease as to

Congo. Wild animals.

their safety, relying upon their natural strength. They often approach the houses without doing any injury, and seldom pay any attention to the men that come in their way. Yet sometimes one of them has been seen raising a negro with his trunk, holding him suspended for some time, and then calmly letting him down again to the ground. The natives of this country have not the art of taming elephants: the only way, therefore, in which they can obtain profit from them is, by sending some of their bravest men to hunt them in the woods. The most common means through which this is done, is by digging deep pits in the ground, which are covered over with branches and leaves, in the same manner as is practised on like occasions in most parts of Asia. The business is generally attended with a good deal both of labour and of danger; but the esteem in which some of the exuviæ of the animal are held in the country is such, as to induce persons, from time to time, to undertake it. Besides elephants, this country abounds also in lions, which in like manner grow here to a vast size, tigers, wolves, and other beasts of prey. There is also a vast variety of monkeys of all sizes and shapes. The zebra of this country is a beautiful animal, which the natives hunt on account of its flesh, which they esteem a dainty food, and for its hide, which they send to Europe as a valuable commodity. A variety of buffaloes and wild asses occur here, and the dante seems to be an animal peculiar to this kingdom. It resembles an ox in shape and colour, but is not so large; its horns are like those of a he-goat, but very smooth and shining, and of a blackish hue. Its skin is commonly bought by the Portuguese, and sent into Germany to be tanned, and made into a kind of targets, which are known by the same name as the animal. Of the raw hides dried the natives make their shields, which are impenetrable to darts and arrows, and at the same time large enough to cover the whole body. They also make a variety of toys from its horns. The dante is a creature of great swiftness; and, when wounded, it will follow the scent of the gun-powder with such fury, that the huntsman finds it necessary, before he ventures to fire, to secure always a retreat in some tree, to which, in case of being unsuccessful in his aim, he may betake himself as speedily as possible. The wounded beast, finding its enemy out of its reach, stays for him at the foot of the tree, and will not stir from its place, while the hunter, taking advantage of this circumstance, dispatches it with repeated shots. Cameleons abound in Congo; and it has several sorts of wild rats, as the ninge, the niosse, and the marmoni, the furs of which surpass even those of the finest tigers, in the beauty, variety, and regularity of their streaks and spots. Another singular small quadruped is said to be found in this country, called the *entiengia*, which abides constantly in the trees, and is reported to die immediately upon setting its feet on the ground. Its skin is beautifully spotted, and is so much in esteem as an article of dress, that, in the country, none but the sovereign, and a few other privileged persons of the first rank, are permitted to wear it. It is at the same time looked upon as a proper present for the most considerable of the neighbouring princes, and as such is received by them with satisfaction.

The forests of Congo swarm with wild dogs, which like wolves prey upon the tame cattle, and are so fierce that they will attack armed men. The teeth of these animals are exceedingly keen and sharp. They never bark; but when famished, or in pursuit of their prey, they set up a dreadful howling. The different kinds of birds are found here that occur in other warm climates. Those called the birds of music are held in such esteem, that persons of the highest rank have, from time immemorial, taken pleasure in keeping them in cages and aviaries, for the sake of their surprising melody. There is a species of parrot, of which description of birds there is here a great variety, distinguished both by their size and colour. Others of the birds of the country the Congoese associate with their superstitions, a trait of character by which that people have been very greatly distinguished. What they esteem the most dreadful of the ominous kind of their birds, are crows, ravens, bats, and owls. Above all others, the great owl is looked on with the most terrible apprehension, and is known in the language of the country by the same name which is used to denote the devil. Both land and sea-fowls, in general, are here very numerous. The ostriches of this country are very large and beautiful, and their feathers, mixed with those of peacocks, which are no less numerous and beautiful, are used as ensigns or standards. They are also made into umbrellas. Turkies, geese, hens, and ducks, both wild and tame; likewise pheasants, pigeons, doves, woodcocks, and other smaller birds, abound in the country. Birds of prey, such as eagles, vultures, falcons of various sorts, sparrow-hawks, and others of a similar kind, occur in great numbers. Herons, bitterns, a bird in size and shape like a crane, one called by the Portuguese the pelican, of a large size and whitish colour, another called the fisher, which darts from a surprising height in the air on the fish, which he perceives in the sea or rivers, with other birds of the like voracious kinds, commonly abound in the marshes, lakes, and other waters.

Congo. Birds.

Tame animals.

Among the tame animals of Congo are enumerated oxen, sheep, hogs, horses, mules, and asses. The attention of the Portuguese has been in some degree directed to particular classes of these animals, especially to the cows, sheep, and goats, chiefly on account of their milk. They have not, however, learned the art of making butter or cheese.

Fish, serpents, &c.

Of fish, the sea adjoining to this country, and its rivers, afford great plenty and variety. It is likewise infested with various kinds of serpents, some of them of great magnitude, with rattle-snakes, vipers, and other venomous reptiles; also scorpions, and other venomous insects, both flying and creeping of several kinds. Lopez makes mention of a serpent of vast dimensions, and of a throat and belly so capacious, that it can swallow a stag entire. The negroes call it by a name, signifying in their language, 'the great water serpent.' It lives in rivers, but it seeks its prey on land. There it climbs up some tree, from which it watches the beasts. Having found an opportunity of attacking an animal, it twists itself around it, grasps it closely with its tail, and kills it with its bites. It then draws it into some retired place, where it devours it at ease, even to the skin, the bones, and the horns. Thus satisfied, it falls into so profound a sleep, that a child might then put it to death. It remains in this state for the space of five or six days; and it is commonly after it has been thus gorged, that it changes its skin. It extends itself on other occasions in the highways like a piece of wood, of which it has then all the appearance, and, with a swift movement, darts upon passengers, whether men or animals. The negroes prefer the flesh of this serpent even to that of chicken. The vipers of this country are several of them extremely poisonous, insomuch that their bite will occasion death within the space of 24 hours; but it is said, that the natives are acquainted with remedies that are sovereign for a cure, if seasonably applied. Of all the descriptions of creatures, however, from which danger is to be apprehended, none occur here more pernicious and fatal than the ants, of which there are enumerated not less than six several species of different colours and sizes, all of them formidable, on account of their prodigious numbers, and the mischief they do, not only to the fruits of the earth, but to men and beasts, whom, upon occasions, they will surround in vast multitudes, and devour to the very bone. They are not less injurious to clothes, linens, and such other stuffs, to which even the hardest wood is not found to afford an adequate defence against them. Yet, amidst this number and variety of destructive insects, there is found here also one species of a more friendly and profitable kind, viz. the industrious bee, which furnishes the inhabitants with honey and wax in such plenty, that there is scarcely a hollow tree, a cleft of a rock, or a chop in the earth, in which their combs are not deposited in great quantities.

Complexion, &c.

The inhabitants of Congo, their colour excepted, which is commonly black, though not unfrequently also of an olive hue, have a great resemblance to the Portuguese. Their hair is black and finely curled; some have it also of a dark sandy colour. Their eyes are for the most part of a fine lively black; in particular instances they are of a dark sea-colour. They have neither flat noses nor thick lips, like the Nubians and the most part of negroes. Their stature is mostly of the middle size. The general indolence of their disposition has been already noticed, which is such as to prevent them in a great measure from reaping the advantages easily within their reach from a soil which, if duly cultivated, would yield not only two, but sometimes even three, crops in the year. These people seem to consider it as unworthy of them to engage in any other exercises than those of dancing, leaping, shooting, and hunting, or on other occasions in smoking and more indolent recreations; whilst the laborious part of their household affairs, as also the operations of digging, sowing, reaping, and the like, are left to the conduct of their slaves,* or in other instances of their wives; and though they have plenty of domestic animals which might easily be trained to undergo the more laborious services, and it might be expected that the example of the Portuguese would incite them to endeavour to turn them in this manner to useful account, it does not appear that they have ever thought of taking the trouble which would be necessary for bringing them into a condition to yield them such valuable assistance. The backward state of things among this people seems not to be in any degree, or to be but little, the consequence of a want of a natural capacity; on the contrary, it is said, that with all their repugnance to any kind of labour in the least degree painful, they have even a most happy disposition for the practice of the mechanical arts. This is exemplified in the singular aptness that has been remarked among the inhabitants of the eastern limits of the kingdom, for the fabrication of different sorts of stuffs, such as velvets, satins, tissues, &c. The thread which they make use of for preparing these stuffs, they draw from the leaves of different trees, which they prevent from rising to too great a height for their purpose, by cutting them annually, and which, by means of frequent watering, they cause to send forth leaves more tender than they would naturally yield, and consequently better fitted for the formation of soft and smooth cloths. The same barks, moreover, as well as other parts of the trees, and indeed generally the different natural productions of their country, they shew not a little ingenuity in turning to various other useful purposes for the arts, or for their better accommodation in life. There is something, it may be added, to be observed here, that is akin to a division of labour, and the prosecution in different situations of different modes of labour respectively the best adapted to them. Thus the inhabitants of the cities are seen subsisting by the profits of their trade. Those who dwell in the country maintain themselves by the returns from agriculture, extremely simple and unimproved as this art indeed is among them, as well as by what they derive from their cattle. Those who border on the sea or on the great rivers, procure their maintenance by fishing.

General character.

The accounts given of the temper, affections, and disposition of mind and heart prevalent among the Congoese, are generally such as are indeed very little to their honour. They are said to be mistrustful, jealous, envious, treacherous, and much inclined to revenge. So devoid are they stated to be of natural affection, that a father will sell his son or daughter, or both, for a piece of cloth, a collar or girdle of coral or beads, a bottle of wine or brandy, or other matters of not greater intrinsic value, or capable of yielding a more permanent satisfaction. A man in this country, if a heathen, may take to himself as many wives as he pleases; or if his Christian profession should prevent this indulgence, he may have, what is the same thing in effect, as many concubines as he judges proper, and has over these such absolute and uncontrouled authority, that in whatever circumstances they may be, even in whatever stage of pregnancy, he may repudiate or even sell them at pleasure. But great as may in reality be the defects of their character, or how much room soever there may be for improvement, either in that or in any thing else relating to their condition, it has been remarked that there is perhaps hardly any nation on earth who have a higher opinion of themselves or of their country than this, or that are more hardened against all conviction to the contrary, from reason, experience, or any comparison of themselves with those whom they may have had opportunities of seeing from different parts of the world. It is a fundamental article of their belief, that the rest of the world was the work of angels, but that the kingdom of Congo, in its full and ancient extent, was the immediate production of the Supreme Architect himself, and of course has vast prerogatives and advantages over all others. When told of the magnificence of the European and Asiatic courts, their immense revenues, the grandeur of their palaces and other edifices, the richness and happiness of their subjects, the great progress they have made in arts and sciences, to which their own country is wholly a stranger, they coolly answer, that all this comes vastly short of the dignity and splendour of the kings and kingdom of Congo, and that there can be but one Congo in the world, to the

* The labour of slaves thus entering so much into the domestic economy of the Congoese, at the same time that the slaves themselves form the main branch of the traffic between this and other nations, they are naturally looked upon as a most valuable description of property, indeed as the chief property which a man can possess, or bequeath to his children or relations.

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happiness of whose monarch and people the rest of mankind were created to contribute, and to whose treasury the sea and rivers constantly bring their riches, whilst other princes and nations must condescend to dig through rocks and mountains in quest of the gold and silver which constitute their wealth, and as such are so generally and so supremely held in esteem amongst them. In conformity with these opinions, they imagine that the nations which come to traffic with them are forced upon that servile employment, from the badness and the poverty of their several countries, not incited to it by their luxury or avarice. For themselves, they consider it to be not a little to their honour, that they can with ease and contentment withstand the solicitations of the most pinching distress, rather than disgrace the nobleness of their blood by any kind of industry, which, however laudable and beneficial such industry may be, they are still disposed to regard as a lesser degree of slavery. They are not, however, equally fastidious in respect to begging or stealing, being indeed the most shameless and importunate beggars in the world, and such determined and outrageous robbers, that the only circumstance on account of which they deem any abstraction of property to be unlawful or scandalous, is its being committed in a private manner, and without the knowledge of the person wronged. It is esteemed a piece of bravery and gallantry to wrench any thing from another by violence; and this description of impudent rapacity is so common, not merely among the vulgar, but also among the great, that they make no scruple in their travels from place to place, to seize not only upon all the provisions they meet with in the towns and villages, but on whatever else comes in their way. In consequence of these violences, the poor people are eager, when apprehensive of such danger, to conceal, in the best manner they can, their few valuables, and esteem themselves happy if not compelled by a severe bastonading to discover them to their oppressors.

Population.

The population of Congo has been represented by some authors, who wrote either from mere conjecture, or from uncertain information, to be but inconsiderable. The missionaries we know, however, and the Portuguese who first visited this country, found it for the most part covered with towns and villages, which even swarmed with inhabitants. The metropolis, it is said, contained above 50,000 souls. The other cities were also filled with people. The provinces, if not equally populous, were yet far from being in this respect strikingly defective. The province of Bamba is even at present said to be able to raise to the amount of 200,000 fighting men; and its former population is said to have been double of what it now contains. The army of the King of Congo in 1665, is stated to have consisted of 900,000 fighting men, who were attended by an infinite number of women, children, and slaves.

Converts to Christianity.

The number of converts to Christianity, which a small number of Capuchin friars made among the more civilized of the people of this country, is affirmed to have amounted to 600,000. These accounts of the numbers of the Congoese will appear the more credible, when we consider the extreme fecundity of their women, the hardiness with which they bring up their children, and the stoutness and healthiness of their men. Consistent with these accounts is the statement we have received as to the numbers of slaves sold annually out of the country, which in ordinary years seldom fall short of 15,000 or 16,000.

The government of Congo is monarchical, and as despotic as any in Asia or Africa. The property of all the lands within their dominions is vested in the king, who parcels them out to individuals on condition of a certain tribute, and of the performance of particular services. Any failure in these respects, or any other neglect, is attended with ejection and deprivation; and the rigour and cruel extortion with which any demands that can be preferred on those grounds are too often enforced, are, as they might well be expected to be, the frequent occasions of revolt or of open rebellion. Even the princes of the blood are subject to the same laws in respect to property as others. Hence it is, that no person whatever, within the limits of this state, can bequeath a foot of land to his heirs; but when the first owners under the crown die, the lands which they held return to it again, whether they were in their own possession or in that of tenants, and it depends entirely on the prince whether then they shall be continued in the same, or disposed into other hands. The crown of this state is partly hereditary and partly elective. No candidate for it accordingly can be chosen, unless he be of the royal blood; and since the introduction of Christianity, it is in like manner necessary that he should be a Christian of the church of Rome. The whole process of the coronation of the prince, and his mode of living after his advancement to the throne, are attended with various circumstances of splendour and magnificence. It is but seldom that he goes abroad, and when he does so, he is attended by a numerous guard of Anseki and others of neighbouring nations, who are the most in his confidence, musicians, knights of the Holy Cross, an order which was instituted by the first Christian king of this country, and a number of officers richly accoutred. The respect which the Congoese pay to their sovereign, approaches even to idolatry. The palace in which he lodges is commodious, grand, and spacious; his court numerous and brilliant; and he has his seraglio, which is plentifully provided with concubines, who there indulge themselves in the most licentious gratifications, but are subject to be detained in it for the rest of their lives, and are placed under the controul of the single lawful wife, which, as to other Christians in this region, is alone allowed, even to the prince.

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Revenue.

The royal revenue consists chiefly in the tribute that is obtained from several vassal princes, in free-will offerings, which are made in acknowledgement for the lands held under the sovereign, in the property of all the zimbis, or that description of shells which constitute the current coin of this and the neighbouring states; in mines of silver and gold, which, however, as serving comparatively little purpose here, are much neglected; and in the sums arising from the renewal of fiefs and investitures, from fines and confiscations. The prince has, moreover, a discretionary power of levying taxes on his subjects at pleasure.

Military force.

The standing forces of the Congoese monarchy are far from being numerous. They are at the same time neither well disciplined nor well clothed, nor well armed. Their mode of fighting is tumultuous and ferocious, and they give no quarter. Those that are taken alive being hurried to the sea-side, or to some inland market, are there sold for slaves to the Europeans.

Laws.

There are no written laws among the Congoese, but where favour or bribery do not interpose, custom and tradition serve them instead both of code and commentaries.

Administration of justice.

Every province has a chief justice for civil and criminal affairs, from whom an appeal lies to the king. Under him there are also inferior officers in every town and community. Treason, murder, and sorcery, are

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here deemed capital offences, of which the two first are punished by decollation, and the last by burning alive. The punishments of lesser offences are the bastinado, hanging, fines, and imprisonment.

Religion.

The religion of Congo was, and still is, in many parts of the country, a compound of the most degrading idolatry and superstition, joined with a complication of absurd and detestable rites, which have been invented by their gangas or priests, for the purpose of keeping the people in a state of the most abject subjection to their spiritual tyranny. There is acknowledged, indeed, one supreme being, called Nzambiamponga, believed to be all-powerful, and to whom is ascribed the creation of the country; but it is understood that the care and government of all sublunary things has been committed by him to a great variety of subordinate deities, who severally preside over their particular departments in nature. In conformity with such views, is the prodigious multiplication that is observed here of deities, idols, and altars, as also of gangas or priests, and of religious ceremonies. The forms under which those inferior deities are represented, vary with the inclination of the worshippers, and consist sometimes in resemblances of different living creatures, sometimes in representations of trees or plants of various kinds, and they sometimes assume the aspect of statues and images, often carved or painted with very considerable skill. The worship that is paid to these imaginary deities is expressed in genuflexions, fumigations, and such other unavailing services, with which the priests have influence and authority enough to join the making of offerings, nominally too in honour of the gods, but really and substantially calculated to benefit, nay even to enrich, those sacred persons themselves. Owing to this influence of the priesthood, not only have the endeavours of the kings of Congo for extirpating idolatry from their dominions been hitherto unsuccessful, but so much are both the most barbarous and the most refined classes of the people of this country, in all their transactions, under the impression of religious regards, that if a house is to be built or occupied, if the harvest is to be cut down, or any thing else, even of the most trifling nature, is to be undertaken, the favour of some deity or deities must ever be gained, through the instrumentality of their servants the gangas. Except in the case of the stated festivals of the new moons, it is the privilege, besides, of this body, to ascertain and fix the seasons generally of all religious observances, as well as the particular rites, sacrifices, and offerings, with which they are respectively to be accompanied; and, indeed, such is the opinion entertained of the highest dignity belonging to this order, that to the chalome, or chalombe, the person invested with it, the degree of reverence that is paid is such as borders on that which is thought due even to the gods themselves. The form of Christianity that was introduced into this country by the Portuguese preachers, after a footing had been obtained in it by that people, was, of course, that of the church of Rome. Even under that form, however, so much has it in later times been neglected, that little really now remains here of that religion except the bare name of Christian.

Concerning dying persons, the idea that is entertained among the Congoese is, that they are just passing from a wretched life into a state of tranquillity and happiness. Hence it is conceived that the best service that can be done to persons in such circumstances, is to accelerate their deliverance; a notion which, among the vulgar, leads sometimes to the barbarous practice of stopping their breath, or beating upon their breasts with violence, that they may the sooner enter into a state of felicity. In the inferior ranks of life, those who mourn for persons deceased shave their whole heads, and anoint themselves with oil, upon which they rub a quantity of earth, dust, and dried leaves, which give them a shocking appearance. Those of better condition shave only the upper part of their heads, which they bind with a list of cloth, linen, or leather, and confine themselves to the house for eight whole days. To shed tears on such an occasion is considered as a great crime, and is liable to punishment even if the culprit should be the king. Upon the death of the monarch, persons kept in pay for the purpose, go to all the public places in the cities to acquaint the people of the fact, by the mournful sound of their ivory cornets. Before the introduction of Christianity into the country, the funeral obsequies of such a personage were celebrated by various kinds of sacrifices and superstitious ceremonies, accompanied with music, howling, dancing, and feasting. These were continued for a week, and were resumed yearly on the anniversary of the king's demise. It was customary also to bury alive a certain number, not exceeding twelve, of the favourite concubines of the prince, or of the young ladies belonging to his court. In some of these respects an advantageous change has taken place in consequence of that event, though the effect has not been so complete as to put an end to the drunken revels which had been customary on such occasions.

The manner of interment for the princes and nobles, is to deposit the dead body in wainscotted vaults, hung with black; two of the old domestics of the parties deceased being destined alternately to guard the entrance, and to give them the benefit of their prayers. Other prayers are in like manner to be offered up on the anniversary of the decease, and on All-souls-day, at which times the graves are opened, and the hangings exchanged for new ones.

Amongst the Giagas, the most barbarous people of this kingdom, it is the custom to dance in a frantic manner about the graves of persons deceased, and to bring them food, drink, and other conveniences. The dances that are performed at the funerals of their great men last for eight days without intermission, upon which occasion there is always sacrificed a number of human victims.

Traffic.

The traffic of the Congoese with the Europeans consisted, for a long period, chiefly in slaves, of whom to the amount of 15 or 16,000 annually used to be carried off the country. In return, there were brought into it various products of Brasil, consisting of grains, fruits, plants, and the like, as also several articles of European manufacture, calculated to supply the necessities, to please the taste, or gratify the luxurious inclinations of the natives and unenlightened inhabitants. Among these are enumerated Turkey carpets, English cloth and the like, copper and brass vessels, ornaments and trinkets of various kinds, tobacco and spirituous liquors, light stuffs for clothing, and a great variety of tools and utensils.

State of the arts, &c.

The imperfect state of improvement in this country, is manifest alike in its general aspect, in the character of its manufactures, and in the nature of the accommodations to be obtained in it. The roads here are bad, and infested with banditti, and a variety of pernicious animals. Nothing almost in any of the de-

Congo ‖ Congreve.

partments of art is such as it might naturally be expected to be found among a people who had advanced far in the progress of civilization. Their houses are low ill-built huts, thatched with straw or fern, without windows, and which are not to be entered into even by the door, without stooping; they are besides so slightly built as to be liable to be blown away by a gust of wind. The furniture consists chiefly of a few ill-contrived instruments of agriculture, a hatchet, a cutlass, with the utensils for preparing or containing their provisions. The Congoese have amongst them a variety of rude musical instruments, such as those which they distinguish by the names of the usambi and the marimba, which are a very imperfect kind of stringed instruments; their ingambos or ingombos, a sort of drum made of the long hollow trunk of a tree, with a single skin stretched over one end of it, and which is beaten with the fists, or by sticks of heavy wood, while the other end of the instrument is left open, and the longa, which consists of one or two small belts. Their dancing has been characterised as merely a promiscuous collection of men and women, all striving who shall show the greatest agility and variety in their gambols, contortions, and indecent postures.

Musical instruments.

History.

Before the arrival of the Portuguese in Congo, its inhabitants were so totally unacquainted with letters that its prior history may be considered as perfectly fabulous. The tradition is, that its first prince was Luguen, the son of a neighbouring sovereign, who gradually united under his dominion the whole of the territory between the mouth of the Zair and the city of St Salvador, and whose legitimate successors have ever since maintained themselves in possession of the throne. This country was discovered by the Portuguese under the reign of John II. who employed Diego Cam, a person of enterprise and a famous navigator, in an expedition for extending the knowledge of the coasts of Ethiopia. The period when this took place was the year 1484. While engaged in this undertaking, Cam was accidentally carried into the Congoese country, and having been well received by the natives, was able to prevail on four of them to accompany him to Europe. Charmed with the accounts which they communicated to him respecting it, the king ordered Cam to return thither as speedily as possible, furnishing him with valuable presents for the sovereign and the court. He directed that this prince should be exhorted to become a convert to the worship of the only true God, and to permit the Christian religion to be propagated through his dominions. Cam, accordingly, having arrived again at Congo in the year 1485, was still very favourably received there, and an alliance having been established between the two crowns of Portugal and Congo, it has still continued to subsist, and was followed by at least a partial conversion of the country to the Christian faith. See Dapper's *Hist. d'Afrique; Mod. Univer. Hist.* vol. xiii. Peuchet's *Dictionnaire de la geographie commerçante; Bibliotheque universelle de Voyages*, &c. (K)

CONGRESS. See AMERICA.

CONGREVE, WILLIAM, a celebrated English dramatist, was descended from a family in Staffordshire, which traced its lineage beyond the Norman conquest. His father was an officer in the army, who was long stationed in Ireland; and in that kingdom young Congreve received so much of his early education, that he was believed by many to be an Irishman. Jacob, his biographer, had indeed told us, on the poet's own assurance, that he was born in England; but Dr Johnson thinks proper to commence the life of this great man, by suspecting him, in this instance, of telling a lie. His reasoning is thus conducted: "Nobody can live long without seeing lies of convenience, or vanity, uttered lightly; and once uttered, sullenly supported. Boileau told a lie to Louis XIV, which he never retracted, and therefore we may suspect that Congreve told Jacob a falsehood respecting the place of his birth." Mr Malone, however, has annihilated this *logical* suspicion, by producing the entry of Congreve's baptism, at Bardsea, near Leeds, in Yorkshire, in 1672. Every page of Johnson's biographies teems with those absurd aspersions on the memory of individuals, and the general character of human nature. Congreve received the first rudiments of his classical education at the high school of Kilkenny, where he is said to have discovered an early poetical vein, in a copy of verses which he wrote upon the death of his master's magpie. He went from thence to the university of Dublin, where, before he left it, at the age of sixteen, his biographer tells us, that he acquired a correct and critical acquaintance with the classics. This may seem almost incredible, yet the mind of Congreve seems to have been endowed with wonderful precocity; and, as we find him consulted by Dryden on his translation of Virgil, it is but fair to believe that he possessed considerable classical knowledge. That species of knowledge a man seldom improves after he leaves the university, and we may believe that Congreve imbibed it at a very early age. He was sent from Dublin to the Middle Temple in London, with a view of studying the law; but he proved one of the many deserters who enlist in that profession; and, at seventeen years of age, published a romance under a feigned name, entitled, *Love and Duty reconciled*. This is the romance which Dr Johnson says he would rather read than praise. We confess our inability to do either, as the romance is not among the books within our reach. The passage, however, in the preface that is quoted in the *Biographia Britannica*, bespeaks a mind wonderfully skilled, at the age of seventeen, in the technical views and language of criticism.

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The first performance that brought him fairly before the public, appeared before he had completed his twenty-second year,—his comedy of *The Old Bachelor*. Dryden and Mainwaring corrected the piece, but the wit and genius were Congreve's. The stuff of it was said to be rich, but those experienced critics give it the cut of the fashion. *The Old Bachelor* was first acted in 1693, before a numerous and splendid audience, and received with thunders of applause: from that period Congreve mounted the throne of comic poetry, and during his life had no rival. Halifax immediately became his patron, and made him one of the commissioners for licensing coaches; and soon after gave him a place in the pipe-office, and another in the customs, worth £600 a-year. Next year he produced his *Double Dealer*, which was not received with equal kindness. Queen Mary honoured the representation of this and the former piece with her presence; and, at her death, which happened not long afterwards, Congreve displayed his gratitude in the pastoral strain, which was then absurdly customary on funeral occasions. In 1695, Betterton opened his new theatre in Portugal-row, Lincoln's-Inn-Fields; and our author supported him by his comedy of *Love for Love:* a comedy which, Dr Johnson remarks, has a nearer alliance to life, and exhibits more real manners, than any of the former. The character of the sailor, Dr

Congreve.

Johnson adds, though pleasant, is not natural; "we well remember," say the authors of the *Biographia Britannica*, in reply to this remark, "that forty years ago the character of Ben was not deemed unnatural. It was then a common tradition," they add, "that Congreve had resided six weeks at Portsmouth, in order to draw the character from living manners." Two years after, he exhibited, in his tragedy of *The Mourning Bride*, that he was qualified for either kind of dramatic poetry. It was well received. The author had not yet completed his twenty-eighth year. About this time he began his dispute with Collier, the puritan successor of Prynne, in hostility to the drama. Collier's attack upon the stage most probably checked its licentiousness: its contingent abuses the dramatic advocates could but lamely defend; but Congreve was sufficiently eloquent in maintaining the general moral utility of the drama. Congreve's last comedy was his *Way of the World*; which, though written with labour and thought, was received with so little favour, that, in disgust, he resolved no longer to commit his quiet or his fame to the caprices of an audience. A masque, entitled *The Judgment of Paris*, and *Semele*, an opera, the first of which only was represented, finishes the list of his works for the stage. From this time his life ceased to be public; he lived for himself and for his friends; engaged in no controversy, contending with no rival, and mixing neither in public animadversions nor personal criticisms. Though adhering to Halifax and the Whigs, he was so far respected by the Tories, that Lord Oxford refused to turn him out of his place; and when his friends returned to power, he was made secretary to the island of Jamaica; a place which, with that in the customs, raised his income to £1200 a-year. Every writer mentioned him with respect: Steele made him the patron of his *Miscellany*, and Pope inscribed to him his translation of the *Iliad*. Having risen, by a happy fortuity, above the griefs of an author's profession, he is said to have affected superiority to the profession itself. The anecdote, of his telling Voltaire, when he came to visit him, that he desired to be considered only as a gentleman, and not as an author, is one of the mortifying proofs, that the wisest may sometimes be foolish. The latter years of Congreve's life were clouded with sickness and infirmity. Cataracts in his eyes at length brought on total blindness; and repeated attacks of the gout prematurely undermined the vigour of his constitution. He sought relief from Bath; but the accident of being overturned in his carriage, left a durable pain in his side, and probably hastened his death, which took place in January 1729, in the sixtieth year of his age. He was interred with great funeral solemnity in Westminster Abbey, where a monument was erected to his memory by Henrietta, Duchess of Marlborough. To this lady, who is said to have had a most romantic regard for him, he left the bulk of his fortune, to the prejudice of relations, whose natural claims, and embarrassed circumstances, it was not to his credit that he neglected.

Congreve's occasional poems are so far beneath mediocrity, that we have reckoned it superfluous to enumerate either their names or their dates. As a writer of comedy, he stands, perhaps, at the head of that department of our drama. Not so much for humorous and natural, as for eccentric delineation of character, and, above all, for the perpetual corruscation of wit and repartee in his dialogue. His wit, indeed, flashes on us even to annoyance; and it is often difficult to distinguish the false wit of his fools, from that which is genuine in his sprightly personages. Mr Murphy, in his *Life of Garrick*, observes on this subject: The frequent surprises of allusion, and the quickness and vivacity of his turns of thought, which abound in Congreve, and which break out when you least expected them, as if a train of wit had been laid all around, put one in mind of those fireworks in a water-piece, which used formerly to be played off in Cupar's Gardens. No sooner one tube, charged with powder, raised itself in various forms and evolutions of fire, but instantly another and another was lighted up; and the pleasure of the spectators arose from seeing secret artificial mines blazing out of an element, in which such machinery could not be expected. To these exceptions we may, however, oppose the eulogistic part of Dr Johnson's character of him: "Congreve has merit of the highest kind: he is an original writer, who borrowed neither the models of his plot, nor the manner of his dialogue. He formed a peculiar idea of comic excellence, which he supposed to consist of gay remarks and unexpected answers; but that which he endeavoured, he seldom failed of performing. His scenes exhibit not much of humour, imagery, or passion; his personages are a kind of intellectual gladiators, every sentence is to ward or strike. But they are the works of a mind replete with images, and quick in combination. Unfortunate as he is in his miscellaneous poetry, he has some traits of genuine inspiration in *The Mourning Bride*, particularly in that proverbially celebrated passage, so frequently quoted:

> *Almeira.* It was a fancied noise—for all is hushed.
> *Leonora.* It bore the accent of a human voice.
> *Alm.* It was thy fear—or else some transient wind
> Whistling through hollows of this vaulted isle.
> We'll listen.——
> *Leon.* Hark !——
> *Alm.* No, all is hushed, and still as death.—'Tis dreadful.
> How reverend is the face of this tall pile,
> Whose ancient pillars rear their marble heads,
> To bear aloft its arched and pond'rous roof;
> By its own weight made stedfast and immoveable,
> Looking tranquillity! It strikes an awe
> And terror on my aching sight; the tombs
> And monumental caves of death look cold,
> And shoot a chillness to my trembling heart.
> Give me thy hand, and let me hear thy voice;
> Nay, quickly speak to me, and let me hear
> Thy voice—my own affrights me with its echoes.

(n)

Coni.

CONI, or CUNEO, from the Latin *cuneus*, a wedge, is a large fortified town of France, and capital of the department of Stura. It is situated at the confluence of the Stura and the Gezzo, upon a tongue of land in the form of a wedge. It stands upon a flat eminence, which commands the whole plain; and though it might still be assailed from the surrounding heights, yet these are generally taken possession of by the garrison when an attack is apprehended. The only buildings worthy of notice are several churches and convents situated without the town. The surrounding country, which is watered with four superb canals, produces grain of all kinds in abundance; and in a season of peace, Coni would be the centre of the commerce of all this part of Piedmont.

Coni derived its origin from a chapel dedicated to the Virgin, built upon the extremity of the tongue of land already mentioned. In 1120, the reputation of this chapel attracted crowds of pilgrims and devotees, and several houses were built for their accommodation. In 1127, an insurrection in the surrounding country contributed to its importance. The peasants of Caraglio and other places, fled from the tyranny of their lords, and built a small fortress in the spot where Coni now stands. In 1125, it was attacked in vain by Francis Stampa, the general of the Swiss army; in 1142, by the famous Claude Annebaud, who was afterwards admiral of France; and in 1557, by the Mareschal de Brissac. In 1796 it was taken by the French, and was added to the French empire in 1803. Population 16,500. See Deninas *Tableau Historique, Statistique et Morale de la Haute Italie*, p. 48, Paris, 1805; and Breton's *Voyage en Piemont*, p. 229, Paris, 1803. This last work contains a view of the town. (π)

CONIC SECTIONS.

Definition.

If a cone indefinitely extended be cut by a plane in any manner, the common section of its surface and the plane will be a geometrical line, which will be a curve in every case in which the plane does not pass through the vertex. The curves which may be formed in this way, although agreeing in some of their properties, will yet differ in others. There can only, however, be three varieties; an *Ellipse*, which is formed when the cutting plane passes in any direction across the cone; a *Parabola*, when it is parallel to one side of the cone; and an *Hyperbola*, when it has any other position. The cone may also be so cut that the section may be a *Circle*, but this curve may be considered as a kind of ellipse; so that, upon the whole, there are only three distinct curves. Their properties constitute a very extensive mathematical theory, a brief view of which is to form the subject of the present article. But before we proceed to the theory itself, it will be proper to give a short account of its origin.

History.

It is well known that almost all the discoveries and improvements in the mathematics have had their origin in the efforts which have been made to resolve problems. It cannot be doubted but that the attempts which have been made to square the circle, although abortive, have led to the discovery of many interesting properties of that figure: Another problem of far less difficulty, is commonly supposed to have called the attention of mathematicians to the conic sections, namely, the duplication of the cube, or, its equivalent, the finding of two mean proportionals between two given magnitudes.

When the ancient mathematicians had succeeded in making a figure similar to any given plane figure, and having to it a given ratio, they would be led by analogy to extend the problem to similar solids: and as these are to one another as the cubes of their corresponding lineal dimensions, the whole difficulty would be reduced to the making a cube that should have any given ratio to a given cube. The case when the ratio was that of 2 to 1 might be expected to be most easily resolved, and hence the duplication of the cube would occupy the attention of the first cultivators of geometry.

An ancient writer has, however, assigned a less natural origin to this problem. A pestilence is said to have ravaged Attica, and in the time of this calamity a deputation was sent to Delos to consult the oracle by what means the celestial anger might be assuaged. The god was very moderate in his demands; he only required that his altar, which was in the form of a cube, should be doubled. This was thought easy, and another of double the *lineal* dimensions was constructed. The true meaning of the god, however, was mistaken; for the new altar was evidently eight times greater than the old one: no wonder then that the plague raged as fiercely as ever. Upon a second application to the god, his order was exactly comprehended, and the affair was referred to Plato, in whose school geometry was at that time held in the highest estimation.

Plato.

There can be no doubt but that the abstract geometrical problem has been interwoven with the fable to give it a greater degree of interest; but it is certain, that this very problem was greatly agitated in the Platonic school; and, as from its nature, it cannot be resolved merely by straight lines and circles, the only lines at first admitted into geometry, it became necessary to inquire what other lines next in order of simplicity to these would afford a solution of this and similar problems, and this investigation would naturally lead to the conic sections.

Menæchmus.

It is impossible now to say exactly who had the merit of the first discovery. Some attribute it to Menæchmus, a disciple of Eudoxus, and a friend and contemporary of Plato. This opinion rests on his being the first on record that resolved the problem of finding two mean proportionals by the conic sections; and on some verses subjoined by Eratosthenes to his epistle to King Ptolemy, where they are called *the curves of Menæchmus.* However this may be, it is certain, that of eleven geometers, whose solutions of the problem have been recorded by Eutocius, two only have employed the conic sections, namely, Menæchmus and Apollonius Pergæus, the latter of whom lived at a later period than the former.

The interest which mankind in general take in the mathematical sciences, is but little in comparison to that which is excited by works of poetry, oratory, history, and the like, and hence it has happened that the writings of the ancients on these subjects have had a far better chance than their mathematical theories, of descending to the present times. However much we may regret the circumstance, it will not therefore appear wonderful that we now know nothing more than the names of the early cultivators of the conic sections: and of these Aristæus deserves to be particularly mentioned. Pappus of Alexandria informs us, in his Mathematical Collections, that this geometer composed five books *De Locis Solidis,* and as many on conic sections, all which are now entirely lost. The celebrated geometer Euclid is supposed to have been a disciple of Aristæus, at any rate he must have been his very particular friend. We learn from Pappus, that Euclid composed a treatise in four books on conic sections, but that also has been lost.

Conon.

Of several other geometers who appear to have cultivated this theory, we shall only mention Conon the friend of Archimedes; but he is better known as an astronomer than as a geometer.

Archimedes.

The writings of Archimedes shew, that before his time, considerable progress had been made in the discovery of the properties of the conic sections, as he refers to many of them incidentally, and speaks of others

Conic Sections.

as commonly known. Although he did not compose a complete treatise explaining the whole theory, yet he added a new branch to it, viz. that which treats of the areas of the sections, and the solids formed by their revolution about an axis: he demonstrated in two different ways, that the area of a parabola is two thirds of that of its circumscribing parallelogram; and this, for many ages, was the only true quadrature of a curvilineal space that was known. He also shewed what was the proportion of elliptic areas to their circumscribing circles, and of solids formed by the revolution of the different sections to their circumscribing cylinders. His various discoveries on this subject may be regarded as the sublime mathematics of that period.

Apollonius of Perga.

Apollonius of Perga may be reckoned the next in rank to Archimedes among the ancient geometers. He lived at a period about forty years later, that is, about the middle of the second century before the Christian era. He studied in the Alexandrian school under the successors of Euclid, and, besides writing treatises on the more abstruse branches of the mathematics cultivated at that time, he enriched the science by a work on conic sections, possessing a high degree of merit. It consisted of eight books. The first four is supposed to comprehend all that was known on the subject before his time, and the remaining books are reckoned to have contained his own discoveries. Several geometers of antiquity wrote commentaries on this work. Among the Greeks we find Pappus, who illustrated them by lemmas or preliminary propositions prefixed to each book. The learned Hypatia, the daughter of Theon, also wrote a commentary, which, however, is now lost, but another by Eutocius, on the first four books, is still extant. In later times, when the Arabians began to collect the fragments of knowledge that had escaped the wreck of the sciences in preceding ages of barbarism, the conics of Apollonius were one of the first works of which they undertook a translation. It was begun under the Caliph Almamon in the year 830 of the Christian era, and what had been prepared was revised and continued in the course of the same century by Thebit Ben-Cora. A new translation was made under the Caliph Abu-Calighiar, in 994: This version afterwards fell into the hands of the Italian geometer Borelli, as we shall presently have occasion to state. The Persian geometer and astronomer Nassir-Eddin, wrote notes on this work in the middle of the 13th century, and Abdolmelec of Scheeraz, another Persian, abridged it: all these versions in manuscript were at last found in Europe.

Hypatia.

Eutocius.

For a long time, however, only the first four books were known; and these in the Greek tongue, are the only part of the original work that has descended to modern times. When, or by what accident, the remainder was lost, is unknown. It existed, however, in the days of Pappus, who lived in the fourth century; for that geometer has, in his mathematical collections, given some account of each book, and of the *lemmata* employed in the demonstration of the propositions. Guided by these, mathematicians in modern times undertook the restoration of the books supposed to be lost; and in particular Maurolicus, a Sicilian geometer of the 17th century, composed a work, containing what he conceived to be the substance of the fifth and sixth books, which was published by Borelli in 1654. Viviani, a disciple of Galileo, and one of the most skilful geometers in Italy, had also begun a similar labour; and, while he proceeded slowly and in silence to prepare materials, the learned Golius returned from the East, bringing with him many Arabic manuscripts, among which were the first seven books of Apollonius' conics; but although this discovery was communicated to mathematicians as early as the year 1644, yet, as no translation appeared, the last four books were still regarded as lost. In the year 1658, Borelli discovered in the library of the Medici at Florence, an Arabic manuscript with an Italian title, stating it to consist of the eight books of Apollonius. This, by the liberality of the Duke of Tuscany, he was allowed to carry to Rome, and there, aided by Abraham Ecchellensis, a learned oriental scholar, he undertook a translation of it into Latin.

Viviani.

Meanwhile, Viviani was advised by his friends not to lose the fruit of his investigations, and accordingly, without being made acquainted with the contents of the books that had been found, he proceeded and published the result of his labours, in 1659. The translation made by Borelli, accompanied by learned notes, was published in 1661; and it is remarkable, that in the Arabic manuscript he had found, as well as in that of Golius, and in the abridged version of Abdolmelec which Ravius had brought from the East, and published in 1669, the eighth book is entirely wanting, so that it is now, in all probability, lost for ever. Dr Halley, however, attempted to restore it from the hints afforded by Pappus, and published the fruit of his researches along with the other seven books, and two books on the sections of cylinders and cones, written by Serenus, a geometer who lived in some of the early centuries of the Christian era. It is commonly supposed, that the restoration is so excellent, as to leave but little reason to regret the loss of the original.

The conics of Apollonius procured him the appellation of the *Great Geometer:* a character to which he appears to have been justly entitled, whether we consider the difficulty of the subjects on which he wrote, or the subtlety of his investigations and the skill and success with which he has conducted them. Among the improvements which he introduced into the mode of treating the subject, there is one particularly worthy of remark, because it is one of many instances in the history of science, of the slow progress of the human mind in passing from particular to more general truths. Before his time, the different curves were defined, by supposing right cones to be cut by planes perpendicular to their sides. By this method, three different cones were required to produce the three sections: a right angled cone for the parabola; an acute angled cone for the ellipse; and an obtuse angled cone for the hyperbola: But Apollonius shewed how all the three sections might be formed by any one cone, whether right or oblique.

In the early ages of science, the conic sections were cultivated merely as a geometrical theory, that might afford an agreeable subject of contemplation to the mind, but without a prospect of its ever being applicable to the explanation of the phenomena of nature. The discoveries of modern times, however, have greatly extended its utility, and rendered it by far the most interesting speculation in pure geometry. Galileo shewed, that the path of a body projected obliquely is a parabola, and Kepler discovered that the planetary orbits are ellipses; these facts alone were sufficient to enhance greatly the value of the theory of the conic sections; but the numerous discoveries of Newton that followed went much farther, and incorporated it with those of astronomy and the other branches of natural philosophy.

Conic Sections.

In explaining the nature and properties of geometrical figures, it becomes a question how they are to be defined. A figure may be defined from any one of its properties, which distinguishes it from all other figures of a different kind; but that ought to be chosen which is simple, which shews how the figure may be readily constructed, and which naturally leads to its other properties. The ancients defined the class of curves we are about to consider, by supposing a cone to be cut by a plane; and their example has been followed by several modern writers, who have, upon this principle, composed elaborate and valuable treatises. As the doctrine of solids is, however, a more intricate branch of geometry than that of plane figures, other modern writers, of whom Dr Wallis was the first, have thought it better to define the curves, by shewing how they may be described on a plane, without any reference to a cone; and treatises not less valuable, and (in our opinion) in some respects more simple, have been written on this plan. We propose to follow this second method, believing it to be the best adapted to our work.

If our system of GEOMETRY were written, we should refer to it as often as we had occasion to quote a proposition in the elements of geometry; as, however, from our mode of publication, that article is not yet ready, we shall, in the mean time, refer to the propositions in Euclid's *Elements of Geometry*, as contained in Mr Professor Playfair's edition: and in our article GEOMETRY give a table shewing to what proposition, there, each of Euclid's corresponds.

Catalogue of works on conic sections.

We shall conclude this Introduction with a catalogue of some of the more curious and valuable works on this branch of geometry.

Among the works of Archimedes which have been preserved, there is a treatise, On the Quadrature of the Parabola, and another On Conoids and Spheroids. See Barrow's edition, London, 1675; or Torelli's edition in Greek and Latin, Oxford, 1792; or Peyrard's French translation of Archimedes' works, Paris, 1808.

Apollonii Pergæi Conicorum libri octo, et Sereni Antissensis de Sectione Cylindri et Coni libri duo. This is Dr Halley's edition. The first four books, together with the Lemmata of Pappus, and the commentaries of Eutocius, have been published from Greek manuscripts, accompanied with a Latin translation; the 5th, 6th, and 7th books, which also contain the Lemmata, have been translated from Arabic into Latin; the eighth has been restored by Dr Halley. The books of Serenus are in Greek and Latin.

Collectiones Mathematicæ Pappi Alerandrini, lib. vii. Bononiæ, 1660. Here some account of Apollonius' Conics, and the Lemmata, is given.

Emendatio et Restitutio Conicorum Apollonii Pergæi, authore Francisco Maurolyco. Coloniæ, 1675.

Apollonii Pergæi Conicorum lib. v. vi. vii. *Paraphraste Abalphato Asphahnensi ex Arabico in Latinum* per Abraham Ecchellensem Maronitam redditi, cum notis J. Alfonsi Borelli. Florentini, 1661.

Apollonii Perg. Con. Sect. Lib. v. vi. vii. *in Grecia deperdita, jam vero ex Arabico MS. ante quadringentos annos elaborata opera subitanea Latinitate donati a* Christiano Ravio. Upsal, 1669.

De Maximis et Minimis, Geometrica Divinatione in Quintum Conicorum Apollonii Pergæi adhuc desideratum, autore Vincentio Viviani. Florence, 1659.

De Locis Solidis, Secunda Divinatio Geometrica in quinque libros injuria temporum amissos Aristæi Senioris Geometræ. Aut. Vin. Viviani, &c. *Opus Conicorum, continens Elementa Tractatuum ejusdem Viviani.* Florence, 1701.

Apollonius Cattus, a work on Conics in German, by Benjamin Bramer, printed 1634.

Claudii Mydorgii Patricii Parisini Prodromi Catoptricorum et Dioptricorum: Sive Conicorum Operis ad abdita radii reflexii et refracti mysteria prævii et facem præferentis. Libri iv. priores Parisiis, 1641.

Francisci à Schooten Leydensis de organica conicarum sectionum in plano descriptione. Lugd. Batavor. 1646.

P. Gregorii a Sto. Vincentio *Opus Geometricum Quadraturæ Circuli et Sectionum Coni decem libris comprehensum.* Antwerpiæ, 1647.

Johannis Wallisii *De Sectionibus Conicis nova methodo expositis tractatus.* Oxonii, 1655.

Joannis De Witt *Elementa Curvarum Linearum per Francisum Schooten edita cum Cartesii Geometria.* Amsterdami, 1659 et 1661.

Euclidus Audactus et Methodicus Mathematicaque Universalis. Authori Guarino Angustæ, Taurin. 1671.

Nouvelle methode en geometrie pour les sections des superficies coniques et cylindriques qui ont pour base, des circles, ou des paraboles, des ellipses et des hyperboles; par Ph. de la Hire. Paris, 1673.

Nouveaux elemens des sections coniques, &c. par M. de la Hire. Paris, 1679.

Sectiones conicæ in ix. *libr. distributæ*, &c. Aut. Phil. de la Hire. Paris, 1685.

Sectionum conicarum elementa nova methodo demonstrata. Autore Jacobo Milnes. Oxoniæ, 1702.

Traite Analytiques des sections coniques et de leur usage, &c. *Ouvrage Posthume de* M. le Marquis de l'Hospital. Paris, 1707.

Compendio delle Sezzioni Coniche d'Apollonio di P. Guido Grando, Florent. 1722.

Delle Sezzioni Coniche dedotte movamente in Piano dalcerchio di Vincent Santini. Luca, 1722.

Sectionum Conicarum elementa methodo facillime demonstrata. Autore L. Trevegar, Cantabrigæ 1731.

A Treatise on Conic Sections, by R. Steel. Dublin, 1723.

Elementa Sectionum Conicarum. Autore Nicolas de Martino. Tomii II. Neapoli 1734.

Elements of Conic Sections, in three books, by R. Jack. Edinburgh, 1742.

A Mathematical Treatise, containing a system of Conic Sections, &c. by J. Muller. London, 1736.

Sectionum Conicarum Elementa. Autore Josepho Boscovich. This treatise forms a part of his *Elementa Universæ Matheseos.* Romæ, 1754.

De Sectionibus Conicis, tractatus geometricus, in quo ex natura ipsius Cono Sectionum affectiones facillime deducuntur methodo nova. Autore Hugene Hamilton. Dublin, 1758. There is an English translation of this excellent work.

Sectionum Conicarum libri quinque. Auctore R. Simson. Edinburgi, 1750.

Antonii Rochii *Conicarum Sectionum nova methodo expositurum specimen de proportionum compositione syntagma.* Patavii, 1756.

Introduction aux Sections Coniques, par M. Mauduit. Paris, 1761.

Sectionum Conicarum Compendium. Autore D. Octaviano Cametti. Venetiis, 1765.

The Elements of the Conic Sections, in three books, by W. Emerson. London, 1767.

The Elements of the Conic Sections, as preparatory to the reading of Newton's *Principia*, by the Rev. S. Vince. Cambridge, 1781.

Elements of Conic Sections, &c. by Charles Hutton, LL.D. London, 1787.

Sectionum Conicarum Libri Septem. Accedit Tractatus de Sectionibus Conicis, et de scriptoribus qui earum doctrinam tradiderunt. Auctore Abramo Robertson, A.M. Oxonii, 1792.

A Geometrical Treatise on Conic Sections, in four books, &c. by the Rev. Abram Robertson. Oxford, 1802.

A Short Treatise on the Conic Sections, in which the three Curves are derived from a general description on a Plane, by the Rev. T. Newton. Cambridge, 1794.

A System of Conic Sections adapted to the Study of Natural Philosophy, by the Rev. D. M. Peacock. 1810.

A Compendious and Practical Treatise on the Construction, Properties, and Analogies of the Three Conic Sections, by the Rev. D. Bridge. 1811.

Essai de Geometrie Analytique applique aux Courbes et aux Surfaces du second ordre, par J. B. Biot. Paris, 1810.

A Treatise on Lines of the Second Order. This is part of a work entitled, *Geometry of Curve Lines,* by John Leslie, Professor of Mathematics in the University of Edinburgh.

There is much valuable matter relating to the conic sections in several works, which do not treat expressly on the subject. Particularly, in Newton's *Principia,* lib. i. The learned Jesuits, Le Seur and Jacquier, have given a concise treatise in their commentary on the work, at Prop. 8. lib. i. Maclaurin has treated of the conic sections in his *Geometria Organica,* sect. 1.; in his Fluxions, chap. xiv. and in sect. 2. of the Appendix to his Algebra. Euler has treated of them in his *Introductio in Analysin Infinitorum,* lib. ii. cap. 5. ; and De Moivre in his *Miscellanea Analytica,* lib. viii. cap. 2, The *Synopsis Palmariorum Matheseos* of Jones, also treats of the subject; but it would extend our catalogue too much to name all the writers who have improved the theory. The reader may see a copious list of them in *Bibliotheca Mathematica,* Auctore Fred. Guil. Aug. Murhard. Lipsæ, 1798.

The references in the following treatise are to be understood thus, (20. 1. E.) means the 20th Prop. of the 1st book of Euclid; (2. Cor. 20. 6. E.) means the 2d Cor. of the 20th Prop. of the 6th book; again, (5.) means the 5th prop. of the section in which the reference is found; (Cor. 1.) means the Cor. to the 1st Prop. (2. Cor. 3.) means the 2d Cor. to Prop. 3. and so on.

SECTION I.

Preliminary Propositions.

Prop. 1. *Theorem.*

Plate CCVII. Fig. 1, 2.

Let PEQ, *peq* be two parallel straight lines given by position, and F, *f* two given points in P*p*, a line perpendicular to them, which are equally distant from C the middle of that line, and let CA be a mean proportional between CF and CP; if D be such a point, that DF and DE, its distances from one of the points and the adjacent line, have to each other the given ratio of CF to CA, then also D*f* and D*e*, its distances from the other point and line, shall have to each other the same given ratio.

Join EF, *ef,* producing them until they meet in G; join GC, and draw GD, meeting F*f* in K.

The triangles EPF, *epf* are manifestly equal (34. and 4. of 1. E.) therefore the angles PFE, *pfe,* and consequently the angles GF*f*, G*f*F, GE*e*, G*e*E are equal (15. and 29. of 1. E.) hence GF = G*f*, and GE = G*e* (6. 1. E.), and GC is perpendicular to F*f* (4. 1. E.) Again the triangles EGD, FGK being similar, as also the triangles FEP, FGC, we have

ED : FK (: : EG : GF) : : CP : CF;
Now by hyp. DF : ED : : CF : CA,
therefore ex. æq. inv. DF : FK : : CP : CA, (23. 5. E.);
and since by hyp. ED : DF (: : CA : CF) : : CP : CA,
therefore, ED : DF : : DF : FK;

now the angles EDF, DFK are equal; (29. 1. E.) therefore the triangles EDF, DFK are equiangular (6. 6. E.) and hence the angles FED, KDF are equal, and (in both figures) the angle GED is equal to GDF: The triangles GED, GDF are therefore equiangular, (32. 1. E.) and GE : GD : : GD : GF, and hence also G*e* : GD : : GD : G*f*; now the angle at G being common to the triangles G*e*D, GD*f*, they are equiangular (6. 6. E.) hence the angle G*e*D is equal to GD*f*, and (in Fig. 2.) G*e*E is equal to *f*DK; but it has been shewn that GE*e* is equal to FDG, therefore, in Fig. 1. the angles FDK, *f*DK are equal, and in Fig. 2. the angle FDG is equal to *f*DK; hence, and because the lines E*e*, F*f* are similarly divided in D and K, in either case FD : *f*D (: : FK : *f*K) : : DE : D*e* (3. and A. 6. E. and art. Geometry) and by alter. FD : DE : : *f*D : D*e*.

Corollary. The points F, *f*, D, G are in the circumference of a circle. For it has been shewn, that the angle GDF is equal to GED, and therefore also to the angle G*f*F; hence (21. 3. E.) the points G, D, F, *f*, must be in the circumference of a circle.

Prop. II. *Problem.*

As in last proposition, let PQ, *p q* be two parallel straight lines given by position, and F, *f* two given points in P *p*, a line perpendicular to them, which are equally distant from C the middle of that line, and let CA be a mean proportional between CF and CP; it is required to find a point D such, that the ratio of its distances from each of the given points, and the line adjacent to that point, shall have to one another the given ratio of CF to CA. Plate CCVII. Fig. 1, 2.

Analysis. Let us suppose the problem resolved, or that D is found such, that DF and D*f* being joined, and ED*e* drawn perpendicular to PQ and *p q*, then DF : DE : : D*f*: D*e* : : CF : CA. Draw FE and *fe*, producing them until they meet in G. It follows from the corollary to last Prop. that the points F, *f*, D, G, are in the circumference of a circle; and as this position of the points appears to be all that is required, in order to resolve the problem, we have only to give the line E *e* such a position, that a circle described about the triangle FG*f* may meet it in a point D. Now, there will be two cases of the problem.

Case 1. When the points F, *f* lie between the lines PQ, *p q*, as in Fig. 1.

Case 2. When the lines PQ, *p q*, pass between the points F, *f*, as in Fig. 2.

In the first case, (Fig. 1.) join GC, producing it to meet the circle in L, and E *e* in H, and join FL; then by reasoning, as in Prop. 1. it will appear that the line GCL is perpendicular to F*f*, and therefore is the diameter of the circle (1.3.E.); and consequently, GFL is a right angle, (31.3.E.) and the triangle EPF, which

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Conic Sections.

PLATE CCVII. Fig. 1, 2.

is similar to GCF, (29. and 15. 1. E.) is also similar to FCL, (8. 6. E.) Therefore, LC : CF : : FP : PE or CH, hence, LC.CH=CF.FP, (16. 6. E.); but since the circle must meet the line ED e, CH cannot exceed LC; and therefore CH^2 cannot exceed LC.CH, although it may be either equal to it or less. Hence, CH^2 may be equal to any space that does not exceed CF.FP; and the point H may be on either side of F f.

In the second case, (Fig. 2.) from the position of the points F, f, in respect of the lines PQ, $p\,q$, the point H necessarily falls between C and G, and therefore is always within the circle; hence it may be any where in a line perpendicular to F f at C.

Composition. In each case, draw a line to bisect F f at right angles in C, and, in Case 1. (Fig. 1.) take CB and C b in that line, each equal to a mean proportional between CF and FP, and take H any where in B b; but, in Case 2. (Fig. 2.) H may be taken any where in the line which bisects F f at right angles in C. In each case, through H draw a line parallel to F f, meeting PQ and $p\,q$ in E and e, and draw the lines EFG, $e\,f$G, meeting in G, which will be a point in the perpendicular to F f at C, (as shewn in the first proposition.) Describe, next, a circle about the triangle FG f, and, in Case 1. let this circle meet CB in L, (Fig. 1.) then if FL be drawn, it may be shewn, as in the Analysis, that LC.CH=CF.FP=CB^2 (by construction); therefore B falls between H and L, and so CL is not less than CH; but, in Case 2. (Fig. 2.) the point H falls always between C and G; therefore, in either case, the circle must meet the line E e, Fig. 1. or that line produced, (Fig. 2.); let D be either of the points of section. Draw DF, D f, and the problem is constructed.

Draw DG meeting F f in K; and because the chords FG, fG, and consequently the arcs FG, fG, are equal, in Fig. 1. the angles GDF, GD f are equal, (27. 3. E.); and, in Fig. 2. the angle GDF is equal to GF f, (27. 3. E.); but in Fig. 2. KD f is also equal to GF f, (13. 1. and 22.3.E.); and therefore GDF=KD f: hence in each case GK makes equal angles with DF, D f; and therefore DF : D f : : KF : K f, (3. and A.6 E.) But the lines E e, F f being similarly divided at D and K, (Geometry,) KF : K f : : DE : De, therefore DF : D f : : DE : D e.

Again, the angle GED being equal to GF f, (29. 1. E.) or G fF, that is to GDF, (21. 3. E.) the angles FED, KDF are equal, now the angles FDE, DFK are equal, (29. 1. E.); therefore the triangles EDF, DFK are equiangular, (32. 1. E.) and

ED : DF : : DF : FK,
hence ED : FK : : ED^2 : DF^2 (2 Cor. 20.6.E.)
but ED : FK : : EG : GF : : PC : CF (4. & 2. 6. E.)
and PC : CF : : CA^2 : CF^2 (2 Cor. 20. 6. E.)
therefore, CA^2 : CF^2 : : ED^2 : DF^2
and CA : CF : : ED : DF : : e D : D f.

Cor. 1. This problem is *indeterminate*, or admits of an indefinite number of solutions. For it appears that, in Case 1. (Fig. 1.) the line ED e, in which the point D is always situated, may have any position between the two limits B, b; and that in Case 2. (Fig. 2.) it may have any position whatever, provided, however, that in each case it be parallel to F f.

Cor. 2. For any one position of the line ED e, in which it does not pass through B or b, in Case 1, there are two points D, D′, and no more: because a circle can cut a straight line only in two points. When the line ED e passes through B or b, in Case 1. there is only one point.

Scholium.

Conic Sections. PLATE CCVII. Fig. 1, 2.

As it appears from the construction of the problem, that in both cases, there are innumerable points D, having the property required, viz. two in any line meeting B b between the points B, b, and parallel to F f, (Fig. 1.) or in any line whatever parallel to F f, (Fig. 2.) these points must all lie in some line XDY of a determinate kind, which will be what is called the *locus* of the point that satisfies the conditions of the problem, and the properties of which may be made the subject of a geometrical theory.

The figure of the *locus* depends greatly upon the position of the points F, f in respect of the lines PQ, $p\,q$, or (which comes to the same thing,) the kind of ratio that FD has to DE, and fD to D e. For we have seen in Fig. 1. where CF is less than CA, and consequently the ratio of CF to CA, or of FD to DE is a ratio of minority, that the *locus* extends only to a limited distance on each side of the line F f: and that in Fig. 2. where CF is greater than CA, and the ratio FD to DE is a ratio of majority, the locus recedes to an indefinite distance on each side of F f. This peculiarity of figure shews that there are two distinct species of lines, one is the locus of D when FD has to DE a ratio of minority, and another, when it has a ratio of majority.

Moreover, as in each case, we may suppose the ratio to approach as near to that of equality as we please, there must be an intermediate species, which may be regarded as the limit to either of the other two. Now, since (Fig. 1. and 2.) F f : P p (: : CF : CP : : CF^2 : CA^2) : : FD^2 : DE^2; when this last ratio approaches to that of equality, the lines F f, P p must also approach to equality; so that if we suppose the point F and line PQ to be given by position, the other point f and line $p\,q$ will recede from them continually; and the ratio of FD to DE becoming absolutely that of equality, the point f and line $p\,q$ will have gone off to an infinite distance, or, in other words, they will no longer exist.

These three species of lines were denominated Conic Sections by the ancient geometers, because they may also be defined by the section of a cone and plane.

They gave the name Ellipse to the line which is the *locus* of D, when FD has to DE a ratio of minority; they called it an Hyperbola, when the ratio was that of majority; and a Parabola, in the case of a ratio of equality. We shall now explain the principal properties of these lines in the following Sections.

SECTION II.

Of the Ellipse.

Definitions.

1. Let PEQ, $p\,e\,q$ be two parallel straight lines given by position, and F, f two given points between these lines in P p a line perpendicular to them, equally distant from C the middle of that line; and in P p, let CA, C a be taken in contrary directions, each equal to a mean proportional between CF and CP, then, if a point D be supposed to move in the plane of the lines, in such a manner, that DF, its distance from one of the given points, has to DE, its distance from the given line adjacent to that point, the given ratio of CF to CA, and consequently (Sect. I. prop. 1.) so that D f, its distance from the other point, has to D e, its distance from the other line, the same given ratio; the point D will describe a curve line called an *ellipse*. PLATE CCVII. Fig. 3.

2. Each of the lines PQ, $p\,q$ is called a *directrix*.

3. Each of the points F, *f* is called a *focus*.

4. The given ratio of CF to CA is called the *determining ratio*.

5. The point C is called the *centre* of the ellipse.

Cor. to Def. 1. The ellipse passes through the points A, *a*; and these are the only points in which it can meet the line A*a*: For, since CA : CP : : CF : CA, therefore, CA—CF : CP—CA : : CA : CP : : CF : CA, (19. 5. E.), that is, FA : AP : : CF : CA. Also, since C*a* : CP : : CF : C*a*, therefore C*a*+CF : CP+C*a* : : CF : C*a*; that is, F*a* : *a*P : : CF : C*a* or CA. The truth of the second part of the corollary is evident from the way in which a line is divided into parts having a given ratio.

Cor to Def. 1, 3, 4. If a straight line MF*m* be drawn through F either of the foci, at right angles at A*a*, and FM and F*m* be each taken to FP in the determining ratio, the points M, *m* will be in the ellipse; and these are the only points in which the line M*m* can meet the curve.

Def. 6. The straight line A*a* is called the *Transverse Axis*.

7. The points A, *a*, the extremities of the transverse axis, are named the *Vertices*.

8. The distance of either focus from the centre is called the *Eccentricity*.

Cor. to Def. 2, 3, 4, 6. The distance between the foci has to the transverse axis, also the transverse axis has to the distance between the directrices, the determining ratio.

Prop. I.

Fig. 3. The sum of two straight lines drawn from any point D in the ellipse to the foci, is equal to the transverse axis.

For ED : DF : : P*p* : A*a*,
and *e*D : D*f* : : P*p* : A*a*,
therefore ED+*e*D : DF+D*f* : : P*p* : A*a*:
But ED+*e*D=P*p*, therefore DF+D*f*=A*a*.

Scholium.

Some writers on conic sections employ this property in defining the ellipse thus: Let F and *f* be two given points in a plane, and let a point D move on that plane so, that the sum of its distances from the given points may be equal to a given line; then the path of the moving point will be an ellipse.

The property in question affords also an easy mechanical description of the curve: Let the extremities of a string, equal in length to the transverse axis, be fixed at the foci F, *f*, and let the string be stretched into the straight lines DF, D*f* by a pin held at D, while the point of the pin is moved upon the plane, then it is manifest that the point will trace an ellipse.

Prop. II.

Fig. 4. Let FM, a perpendicular to the transverse axis at either focus, terminate in the ellipse at M, and let a circle be described on F as a centre, with FM as a radius, then if, from any point D in the curve, a line DF be drawn to the focus, and produced to meet the circle in I, and IN be drawn perpendicular to the axis, the rectangle contained by the variable lines PN, FD is equal to the constant rectangle PF.FM.

Draw DE perpendicular to the directrix, and join EF and PI: Then, because FM or FI : FP : : FD : DE (Cor. to Def. 1, 3, 4), and the angles EDF, PFI are equal (29. 1. E.), the triangles EDF, PFI are similar (6. 6. E.), therefore FE is parallel to PI (28. 1. E.): Hence the angles EFP, IPN are equal, and the angles at P and N being right angles, the triangles EPF, PNI are also equiangular, and FD : FI (: : FE : PI) : : FP : PN (4. 6. E.), therefore FD.PN= FP.FI=FP.FM (16. 6. E.)

Cor. From this proposition we may determine D, the point in which a line FD given by position, passing through the focus meets the curve, viz. by taking a point I in DF produced, such that PF may be to FI in the determining ratio, and drawing IN perpendicular to PF, and taking FD a fourth proportional to PN, PF, and IF.

Scholium.

From this proposition we may get a correct notion of the figure of the ellipse, by considering the changes which take place in the magnitude of the line FD, while the angle PFD gradually changes, increasing from nothing to two right angles. For let us first suppose the line FD to come to the position FA, then the point N will recede to L, the extremity of the diameter of the circle farthest from P; and as in every position of the line FD, the rectangle PN.FD is equal to the constant rectangle PF.FM, when the point N is at L, so that PN is the greatest possible, then FD will be the least possible. Suppose, now, the line FD to depart from the position FA, and to revolve about F; then, as the angle PFD increases, the point N will approach to L′, the extremity of the diameter nearest to P, arriving at it when the revolving line coincides with P*a*: the line PN will now be the least, and (because the rectangle PN.FD is equal to the constant rectangle PF.FM) the line FD will be the greatest possible: and as PN has had all degrees of magnitude between the two limits PL and PL′, so FD will have had all degrees of magnitude between FA and F*a*.

If the line FD be supposed to continue its revolution, and to move to the other side of the axis A*a*, it will decrease exactly as it had increased, until at last, after a complete revolution, it returns to its least magnitude FA. Upon the whole, we may draw the following conclusions:

1. The ellipse is a continuous line, surrounding a space in which the foci and centre are situated.

2. Of all the lines which can be drawn from either focus to the curve, the shortest is the part of the conjugate axis between the focus and nearest vertex, and the greatest is the remainder of that axis; and of the rest, that which is nearer to the least is less than that more remote.

3. Lines drawn from either focus to the curve, making equal angles with the axis, and lying on opposite sides of it, are equal to one another.

Definition 8.

A straight line B*b* passing through the centre, at right angles to the transverse axis, and terminating in the curve, is named the *Conjugate Axis*. Fig. 3.

Prop. III.

The distance of either extremity of the conjugate axis from either focus is equal to the semitransverse axis.

For, draw BF to either of the foci, and BG perpendicular to the directrix. Then FB : BG : : CA : CP or BG, therefore FB=CA. Fig. 3.

Cor. 1. The conjugate axis is bisected at the centre, for, join F*b*; and, because FB=F*b*, the angle FBC is equal to F*b*C (5. 1. E.), and the angles at C being right angles, and the side FC being common to the triangles

Ellipse.

FBC, FbC, they are in all respects equal (26. 1. E.), hence $BC=bC$.

Cor. 2. The square of the semiconjugate axis is equal to the rectangle contained by the parts into which the transverse is divided at either focus. For $AC^2=AF.Fa+FC^2$ (5. 2. E.) and $FB^2=FC^2+CB^2$ (47. 1. E), therefore since $AC^2=FB^2$, it follows that $AF.Fa=CB^2$.

Cor. 3. The square of the semiconjugate axis is also equal to the rectangle contained by the eccentricity and the distance of either focus from its directrix. For since PC : CA : : CA : CF (Def. 1.) $PC.CF=CA^2$ (17. 6. E.) now $PC.CF=PF.FC+CF^2$ (3. 2. E.), and $CA^2=BF^2=BC^2+CF^2$; therefore $PF.FC=BC^2$.

Definition 10.

A straight line which meets an ellipse, and being produced does not cut it, is said to *touch* the ellipse, and is called a *Tangent.*

Prop. IV. *Problem.*

Having given the transverse axis and a focus, and consequently its directrix, to find the points in which a straight line given by position perpendicular to the axis, meets the ellipse.

Fig. 5. Let Aa be the transverse axis, F the focus, PQ the directrix, and Ll the line given by position, which meets the axis in G: let FM perpendicular to the axis at F meet the curve in M: draw PM meeting the line given by position in L: describe a circle on F as a centre, with GL as a radius, meeting Ll in D, and d, and these will be two points in the ellipse.

For, join FD, Fd, and draw DE, de perpendicular to the directrix. Then the triangles PGL, PFM are manifestly similar, therefore GL : GP : : FM : FP; or, since ED and ed are each equal to FG (34. 1. E.), FD : DE, also Fd : de : : FM : FP, that is in the determining ratio (Cor. to Def. 1, 3, 4.); therefore D and d are points in the ellipse.

It appears that the problem can be resolved only when Ll has such a position that GL is not less than FG. To determine the limits within which this happens, draw AH, ah perpendicular to the axis, meeting PL in H and h; and join FH, Fh; then, by similar triangles, PF : FM : : PA : AH : : Pa : ah, but PF : FM : : PA : AF : : Pa : aF (Cor. to Def. 1, 3, 4.), therefore, $AH=AF$, and $ah=aF$. Now, let GL meet either of the lines Fh, FH in N, then $GN=GF$, and G being any point between A and a, GN, or GF, is less than GL; but at the points A, a, GN is equal to GL, and at any point in Aa produced, GN is greater than GL; therefore the problem will be possible only when the point G is any where in the line Aa.

Cor. 1. Every straight line perpendicular to the transverse axis between its extremities, meets the curve in two points, and no more; also at the extremities it meets the curve in one point only; and beyond the extremities it falls entirely without the curve.

Cor. 2. In the ellipse, every straight line perpendicular to the transverse axis, and terminating in the curve, is bisected by the axis.

Cor. 3. A perpendicular to the transverse axis at either of its extremities is a tangent to the curve.

Cor. 4. The transverse divides the ellipse into parts exactly alike.

Prop. V. *Problem.*

The transverse axis, and a focus, and consequently its directrix, being given, to find the points in which a straight line given by position parallel to the axis meets the curve.

Fig. 6. Let EH, the line given by position, meet the directrix in E, and the conjugate axis Bb, in H; draw EF through the focus, to meet HG in G: On G as a centre, with a radius equal to a mean proportional between GF and GE describe a circle, meeting EH in D and d, and these will be points in the ellipse. For, join DF, dF, DG, dG, and because EG : GD : : GD : GF, and the angle at G, is common to the triangles EGD, DGF; these triangles are equiangular (6. 6. E.), and ED : DF : : EG : GD; therefore $ED^2 : DF^2 : : EG^2 : GD^2$ (22. 6. E.); but $EG^2 : GD^2$: : EG : GF (2. Cor. 20. 6. E.) : : PC : CF (2. 6. E.), and $PC : CF : : AC^2 : CF^2$ (2. Cor. 20. 6. E.) therefore $ED^2 : DF^2 : : AC^2 : CF^2$, and ED : DF : : AC : CF; hence D is a point in the ellipse, and in the same manner it may be shewn that d is a point in the ellipse.

It appears that this problem can be resolved only when GH does not exceed GD, a mean proportional between EG and GF, and this circumstance restricts the position of the line given by position within certain limits. To determine these, draw FL perpendicular to FG, to meet GH in L. Then the triangles GHE, GFL will be equiangular (32. 1. E.), therefore EG : GH : : GL : GF; hence $GH.GL=EG.GF$ (16. 6. E.)$=GD^2$ (by construction): and as GH^2 may have any magnitude that does not exceed GD^2, therefore CH^2 must not exceed GH GL, that is, GH must not exceed GL, or CH must not exceed CL, or CH^2 must not exceed CH.CL; but the triangles EPF, FCL being similar, because each is similar to GCF (29. 1. and 8. 6. E.) LC : CF : : FP : PE or CH, therefore $CH.CL=FP.FC$ (16. 6. E.)$=CB^2$ (3. Cor. 3.), therefore CH^2 must not exceed CB^2, and CH may have any magnitude not greater than CB, the transverse axis.

Cor. 1. If an indefinite straight line meets the conjugate axis at right angles between its extremities, it cuts the curve in two points, and no more; if it pass through either extremity, it meets the curve in one point only; and if it meets the conjugate axis produced, it falls entirely without the curve.

Cor. 2. Every straight line perpendicular to the conjugate axis, and terminating in the ellipse, is bisected by that axis.

Cor. 3. A perpendicular to the conjugate axis at either of its extremities, is a tangent to the ellipse.

Cor. 4. The ellipse is divided into two parts exactly alike by the conjugate axis.

Prop. VI.

Fig. 7. If from any point Q in the directrix, a straight line be drawn to meet the ellipse in D, and LFl, a parallel to the directrix, passing through the focus, in H; and if another straight line be drawn to D through F, and a perpendicular QK be drawn to FD; the lines FH, QK have to each other the determining ratio.

Draw DE perpendicular to the directrix, and let DF meet it in I. The triangles DHF, DQI are equiangular (29. 1. E.), and the triangles QIK, DIE are also equiangular, for the angles at K and E are right angles, and the angle at I is common; therefore FH : FD (: : QI : ID) : : QK : DE (4. 6. E.), and by alternation, FH : QK : : FD : DE, that is in the determining ratio.

Cor. 1. If a straight line meet the directrix in Q, and the parallel Ll in H; and if a straight line KFD pass through the focus, and FH have to KQ, (the distance of KF from the point Q), the determining ratio, the lines QH, KFD will meet at a point D in the ellipse: For then, FD : DE : : FH : QK, that is in the determining ratio.

Cor. 2. If QF be drawn to the focus, and in the line LFl parallel to the directrix, there be taken FL, Fl in contrary directions, and each to QF in the determining ratio, then every straight line drawn from Q to meet the ellipse, will either pass between the points L, l, or through these points. For since by hypothesis FQ : FL : : KQ : FH; and since KQ cannot exceed FQ, therefore FH cannot exceed FL.

Cor. 3. Any straight line drawn from Q to cut the line Ll beyond the limits L, l falls without the ellipse.

Prop. VII. *Problem.*

Having given a focus, its directrix, and the determining ratio, to find the points in which a straight line given by position, and not parallel to the directrix, meets the ellipse.

Fig. 8. Case 1. Let XY, the line given by position, pass through F the focus; draw FQ perpendicular to XY, meeting the directrix in Q; and in LFl, a line passing through the focus parallel to the directrix, take FL and Fl, each to KQ in the determining ratio; and because FL and Fl are each less than FQ, the angles FQL, FQl are not right angles (Geometry), therefore the lines QL, Ql will always meet the line XY in two points D, d, which will be points in the ellipse, as is evident from Cor. 1. Prop. 6.

Fig. 9. Case 2. Next, let the line given by position meet the directrix in Q, and Ll the line passing through the focus parallel to the directrix in H; so that QF being drawn to the focus, and FL and Fl taken each to FQ in the determining ratio, the point H falls between the focus, and either of the points L, l. In QF take QN, so that FH may have to QN the determining ratio, then FH : QN : : FL : QF; but FH is less than FL, therefore QN is less than QF: On Q as a centre, with QN as a radius, describe a circle, and draw FK, Fk tangents to it, also draw FO perpendicular to QH; then, as FH is less than KQ, FO will be much less than KQ, or kQ; therefore the lines KF, kF cannot be parallel to QO, and they must, if produced, meet it in two points D, d, which will be points in the ellipse, as is evident from Cor. 1. Prop. 6.

Fig. 9. Case 3. Lastly, let the line given by position meet the directrix in Q (Fig. 9.), and be so situated, that QF being drawn to the focus, and FL and Fl each taken to QF in the determining ratio, the line passes through L, either of the extremities of the line Ll; then it will appear, as in the first case, that FQL cannot be a right angle; therefore, FD′ being drawn perpendicular to FQ, will meet QL in D′, a point in the ellipse, Cor. 1. Prop. 6.

Cor. 1. The points L, l being determined, as in the second and third cases, any straight line drawn from Q, to pass between them, will meet the ellipse in two points, and no more: For it has been shewn, that the tangents FK, Fk must always meet the line given by position in two points D, d; and as these are evidently the only lines which can be drawn through F, so that FH may have to QK, Qk, (their distances from Q) the determining ratio, there can be no more than two intersections of the line QH and the ellipse.

Cor. 2. If from D, d, the intersections of a straight line and an ellipse, straight lines DF, dF be drawn to a focus, these make equal angles with QFR, a line drawn through the focus from Q the point in which the intersecting line meets the directrix. For the angles dFQ is equal to KFQ or DFR.

Cor. 3. The points L, l being determined as in the proposition, a straight line drawn from Q through either of these points is a tangent to the ellipse. For in this case only one line FD′ can be drawn through F, so that FL has to FQ its distance from Q, the determining ratio, and it appears that the ellipse lies wholly on one side of FL, (Cor. 3. 6.) therefore FL is a tangent. (Def. 10.)

Cor. 4. If a straight line meet an ellipse, it will either touch it, or cut it in two points, and in no more. This follows from the Prop. and Prop. 4. and 5.

Cor. 5. If two straight lines FD, FQ (Fig. 10.) which contain a right angle at the focus, meet the curve and the directrix in D and Q; the straight line DQ, joining these points, is a tangent to the ellipse at D; and only one tangent can be drawn to the curve at that point. It is evident from the construction of Case 3. and Cor. 3. that the line DQ is a tangent. To prove that there is no other tangent at D, draw any other line DQ′ through D; if this line be parallel to the directrix, it will cut the curve (Prop. 4.) but if it be not parallel, let it meet the directrix in Q′, and FH a parallel to the directrix passing through the focus in H. Draw Q′K perpendicular to FD; join Q′F; and take FL to Q′F in the determining ratio; and because D is in the ellipse, FH has to Q′K the determining ratio (6.) therefore FQ′ : FL : : Q′K : FH, but FQ′ is greater than Q′K, therefore FL is greater than FH; hence the line Q′H must meet the ellipse in two points by Cor. 1. of this proposition. Fig. 10.

Cor. 6. Tangents DQ, dQ (fig. 8.) at the extremities of any focal chord Dd, and a perpendicular FQ to that chord at the focus, meet at a point Q in the directrix. Fig. 11.

Prop. VIII.

A tangent to the ellipse makes equal angles with straight lines drawn from the point of contact to the foci.

If the tangent be at either extremity of the tranverse or conjugate axis, the truth of the proposition is manifest; in any other case let it touch the curve at D, and meet the directrices in Q and q; draw DF, Df to the foci, and EDe perpendicular to the directrices. The triangles DEQ, Deq, are manifestly equiangular, therefore DQ : DE : : Dq : De (4. 6. E.) but DE : DF : : De : Df (Def. 1.) therefore ex. æq. DQ : DF : : Dq : Df (22. 5. E.) hence it appears that the triangles DFQ, Dfq, which have the angles at F and f right angles, (Cor. 5. 7.) have the sides about one of the remaining angles in each proportionals, therefore they are equiangular, (7. 6. E) and have the angles QDF, qDf equal.

Definition 11.

A straight line passing through the centre, and terminating both ways in the ellipse, is called a *diameter*, and the points in which it meets the ellipse are called its *vertices*.

Prop. IX.

Every diameter is bisected at the centre.

From D, any point in the ellipse, draw the chord DHd' perpendicular to the conjugate axis at H, and the chord $d'hd$ perpendicular to the transverse axis at h, and join Hh, DC, dC: Then DH = Hd', (2. Cor. 5.) = Ch (34. 1. E.) and HC = $d'h$ = hd (2. Cor. 4.) Fig. 12.

Ellipse. hence the figures DH*h*C, H C *d h* are parallelograms (33. and 34. 1. E.) and as the angles D C *h* and C *h* H, that is (29. 1. E.) the angles DC *h* and *h* C *d* are equal to two right angles, DC and C *d* lie in one and the same straight line (14. 1. E.) therefore DC *d* is a diameter, and as D C=H *h*=C *d* (33. 1. E.) the diameter is bisected at C.

Prop X.

The tangents at the vertices of any diameter are parallel.

Fig. 13. Let D *d* be a diameter, and HDK, *h d k* tangents at its vertices. Draw straight lines from D and *d* to F and *f* the foci. The triangles FCD, *f*C *d* are in all respects equal, for FC=*f*C, CD=C*d*, and the angles FCD, *f*C *d* are equal; therefore the angles CDF, C *d f* are equal, and the lines DF, *d f* are parallel (29. 1. E.) and since DF=*d f*, the figure FD *f d* is a parallelogram, of which the opposite angles D, *d* are equal (34. 1. E.) Now the angles FDH, *f d h*, are half the supplements of these angles (8.) therefore the angles FDH, *f d h* are equal; and hence CDH, C *d h* are also equal, consequently HD is parallel to *h d*. (27. 1. E.)

Cor. 1. If tangents be drawn to an ellipse at the vertices of a diameter; straight lines drawn from either focus to the points of contact make equal angles with these tangents. For the angle FDH is equal to F *d k*.

Cor. 2. The axes of an ellipse are the only diameters which are perpendicular to tangents at their vertices. For let D *d* be any other diameter, then FD, F *d* are necessarily unequal, and therefore the angles FD *d*, F *d* D are unequal, and adding the equal angles FDH, F *d k*, the angles HD *d*, *k d* D are unequal, therefore neither is a right angle. (29. 1. E.)

Prop. XI.

A straight line drawn from either focus of an ellipse to the intersection of two tangents to the curve, will make equal angles with straight lines drawn from the same focus to the points of contact.

Fig. 14. Let HD, H *d* be tangents to an ellipse at the points D, *d*, let a straight line be drawn from H their intersection to F either of the foci, and let FD, F *d* be drawn to the points of contact, the lines DF, *d* F make equal angles with HF. For draw D*f*, *d f* to the other focus, and in FD, F *d* produced, take DK=D *f* and *dk*=*d f*; join HK, H*k*, and draw *f* K, *f k* meeting the tangents at G and *g*. The triangles *f* DH, KDH have D*f*=DK; and DH common to both, also the angle *f* DH equal to KDH (8.) therefore *f* H=KH. In like manner it may be shewn that *f* H=*k* H; therefore HK=H*k*. Now FK=F*k*, for each is equal to FD+D*f*, or F*d*+*d f*, that is to the transverse axis (1.) therefore the triangles FKH, F *k* H are in all respects equal, and hence the angle KFH is equal to *k* FH, therefore DF and *d* F make equal angles with HF.

Cor. 1. Perpendiculars drawn from the intersection of two tangents to straight lines drawn from either focus through the points of contact are equal. For HI, H *i*, perpendiculars to FD, F *d* are manifestly equal (26. 1. E.)

Cor. 2. Straight lines drawn from the intersection of two tangents to the foci make equal angles with the tangents. For the angles FHK, FH *k* being equal, and FHK=FHD+DHK=FHD+DH *f*=2 FHD+FH *f*, and in like manner FH *k*=FH*d*+*d* H *f*=2 *f* H *d*+FH *f*, therefore 2 FHD+FH *f*=2 *f* H *d*+FH*f*, and 2 FHD=2 *f* H *d*, and FHD=*f* H *d*.

Prop. XII.

Ellipse. If there be two tangents at the extremities of a chord in the ellipse, and a third parallel to the chord, the part of this tangent intercepted between the other two is bisected at the point of contact.

Let HD, H*d* be tangents at the extremities of the chord D *d*, and KP*k* another tangent parallel to the chord; and meeting the others in K and *k*; the line K *k* is bisected at P, the point of contact. From the points of contact D, P, *d*, draw lines to F, either of the foci; and from the intersections of each two tangents, draw perpendiculars to lines drawn through the focus from the points of contact, that is draw HI, H *i* perpendicular to FD, F *d*; and KM, K *m* perpendicular to FD, FP; and *k*N, *kn*, perpendicular to F *d*, FP. The triangles DHI, DKM are manifestly equiangular; as also *d* H *i*, *d k* N; therefore, DH : DK : : HI : KM (4. 6. E.) and *d*H : *d k* : : H *i* : *k*N; but K *k* being parallel to D*d*; DH : DK : : *d*H : *d k*; therefore HI : KM : : H*i* : *k*N; now HI=H*i* (Cor. 1. 11.) therefore KM=*k* N, but KM=K *m*, and *k* N=*k n* (Cor. 1. 11.) therefore K *m*=*k n*, and since we have manifestly K*m* : *k n* : : KP : *k* P, (4. 6. E.) therefore KP=*k* P. Fig. 15.

Lemma.

Let HK′*k*′ be a triangle, having its base K′*k*′ bisected at *p*; and let K *k*, any straight line parallel to the base, and terminated by the sides, be bisected at P, then the points *p*, P, and the vertex of the triangle are in the same straight line: and that line bisects D*d*, any other straight line parallel to the base. Fig. 16.

Complete the parallelograms HK′*p*T, HKPS. The triangles, HK*k*, HK′*k*′ being similar, and K*k*, K′*k*′ similarly divided at P and *p*, we have HK : HK′ : : K *k* : K′ *k*′ : : KP : K′*p*; hence the parallelograms HKPS, HK′*p*T are similar. Now they have a common angle at H; therefore they are about the same diameter, (26. 6. E.) that is, the points H, P, *p*, are in a straight line. And if D*d* meet that line in E, we have KP : DE (: : PH : EH) : : P*k* : E *d*, therefore DE=E*d*.

Definitions.

12. Any chord not passing through the centre, which is bisected by a diameter, is called an ordinate to that diameter.

13. The segments into which an ordinate divides a diameter are called *Abscissæ*.

Prop. XIII.

Any chord not passing through the centre, but parallel to a tangent, is bisected by the diameter which passes through the point of contact; or it is an ordinate to that diameter.

The chord DE *d*, which is parallel to K *k*, a tangent at P is bisected at E by the diameter P *p*. Draw K′*p k*′ a tangent at *p*, the other end of the diameter; and DH, *d* H tangents at D, *d*, the extremities of the chord meeting the other tangents in K, *k*, and K′*k*′. Then KP *k* and K′*p k*′ are bisected at P and *p* (12.) therefore the diameter P*p*, when produced, must pass through H, and bisect D *d*, which is parallel to K′ *k*′ or K *k* in E (Lemma.) Fig. 17.

Cor. 1. Straight lines which touch an ellipse at the extremities of an ordinate to any diameter intersect each other in that diameter.

Cor. 2. Every ordinate to a diameter is parallel to a tangent at its vertex. For if not, let a tangent be

Ellipse.

drawn parallel to the ordinate, then the diameter drawn through the point of contact would bisect the ordinate, and thus the same line would be bisected in two different points, which is absurd.

Cor. 3. All the ordinates to the same diameter are parallel to each other.

Cor. 4. A straight line that bisects two parallel chords, and terminates in the curve, is a diameter.

Cor. 5. The ordinates to either axis are perpendicular to that axis, and no other diameter is perpendicular to its ordinates.

Prop. XIV.

If a tangent to an ellipse meet a diameter, and from the point of contact an ordinate be drawn to that diameter, the semidiameter is a mean proportional between the segments of the diameter, intercepted between the centre and the ordinate, and between the centre and the tangent.

Fig. 17. Let DH a tangent to the curve at D meet the diameter P p produced in H; and let DEd be an ordinate to that diameter, then CE : CP : : CP : CH.

Through P and p the vertices of the diameter, draw the tangents PK, pK′, meeting DH in K and K′; draw PF, pF, DF to either of the foci, and draw KM, Km perpendicular to FP and FD, and K′N K′n perpendicular to Fp, FD. The triangles PKM, pK′N are equiangular, for the angles at M and N are right angles, and the angles MPK, NpK′ are equal, (1. Cor. 10.) therefore PK : pK′ : : KM : K′N (4. 6. E.) : : Km : K′n (1. Cor. 11.) but the triangles KmD, K′nD being manifestly equiangular, Km : K′n : : KD : K′D, therefore PK : pK′ : : KD : K′D : But because of the parallel lines KP, DE, K′p, we have PK : pK′ : : PH : pH and KD : K′D : : PE : pE, therefore PH : pH : : PE : pE; take CG=CE, then, by conversion, PH : Pp : : PE : EG; and taking the halves of the consequents, PH : PC : : PE : EC; hence, by composition, HC : PC : PC : EC.

Cor. 1. The rectangle PE.Ep is equal to the rectangle HE.EC.

For PC^2=HC.CE=HE.EC+EC^2 (17. 6. and 3. 2. E.)
also PC^2=PE.Ep+EC^2 (5. 2. E.)
therefore HE.EC=PE.Ep.

Cor. 2. PH Hp=EH.HC.
For HC^2=PH.Hp+CP^2 (6. 2. E.)
also HC^2=EH.HC+EC HC (1. 2. E.)
=EH.HC+CP^2 (by the Prop.)
Therefore PH.Hp=EH.HC.

Prop. XV.

If a diameter of an ellipse be parallel to the ordinates of another diameter, the latter diameter shall be parallel to the ordinates of the former.

Fig. 18. Let Qq a diameter of an ellipse be parallel to DEd an ordinate to the diameter Pp; the diameter Pp shall be parallel to the ordinates of the diameter Qq.

Draw the diameter dCD′ through one extremity of the ordinate Dd, and join D′ and D the other extremity, meeting Qq in G. Because D′d is bisected at C, and CG is parallel to dD, the line DD′ is bisected at G; therefore DD′ is an ordinate to the diameter Qq; and because dD′ and dD are bisected at C and E; the diameter Pp is parallel to DD′ (2. 6. E.) therefore, Pp is parallel to any ordinate to the diameter Qq.

Definitions.

14. Two diameters are said to be *conjugate* to one another, when each is parallel to the ordinates of the other diameter.

Cor. Diameters which are conjugate to one another are parallel to tangents at the vertices of each other.

15. A third proportional to any diameter and its conjugate is called the *Parameter*, also the *Latus rectum* of that diameter.

Prop. XVI.

If an ordinate be drawn to any diameter of an ellipse, the rectangle under the segments of the former will be to the square of the semiordinate as the square of the diameter to the square of its conjugate.

Let DEd be an ordinate to the diameter Pp, and let Qq be its conjugate, then, PE.Ep : DE^2 : : Pp^2 : Qq^2. Fig. 18.

Let KDL, a tangent at D, meet the diameter in K, and its conjugate in L; draw DG parallel to Pp, meeting Qq in G. Because CP is a mean proportional between CE and CK. (14.)

CP^2 : CE^2 : : CK : CE (2. Cor. 20. 6. E.)
and by division, CP^2 : PE.Ep : : CK : KE;
But because ED is parallel to CL,
CK : KE : : CL : DE or CG;
and because CQ is a mean proportional between CG and CL (14.)
CL : CG : : CQ^2 : CG^2 or ED^2;
therefore, CP^2 : PE.Ep : : CQ^2 : DE^2;
and by inversion, and alternation,
PE.Ep : DE^2 : : CP^2 : CQ^2 : : Pp^2 : Qq^2.

Cor. 1. The squares of semi-ordinates, and ordinates, to any diameter of an ellipse, are to one another as the rectangles contained by the corresponding abscissæ.

Cor. 2. The ordinates to any diameter, which intercept equal segments of that diameter from the centre, are equal to one another, and conversely equal ordinates intercept equal segments of the diameter from the centre.

Cor. 3. If a circle be described upon Aa, either of the axes of an ellipse, as a diameter, and DE, de any two semiordinates to the axis meet the circle in H and h; DE : de : : HE : he. For DE^2 : de^2 : : AE.Ea : Ae.ea : : HE^2 : he^2, therefore DE : de : : HE : he. Fig. 19.

Cor. 4. If a circle be described on Aa, the transverse axis, as a diameter, and DE, any ordinate to the axis, be produced to meet the circle in H, then HE : DE : : Aa : Bb, the conjugate axis. For produce the conjugate axis to meet the circle in K, then (by last Cor.) HE : DE : : KC or AC : BC : : Aa : Bb.

Cor. 5. If HE be divided at D, so that HE is to DE as the transverse to the conjugate axis, D is a point in the ellipse, and DE is a semiordinate to the axis Aa.

Prop. XVII.

The transverse axis of an ellipse is the greatest, and the conjugate axis the least, of all its diameters.

Let Aa be the transverse axis, Bb the conjugate axis, and CD any semidiameter. Draw DE perpendicular to Aa, and DL perpendicular to Bb; and because Aa^2 : Bb^2 : : AE.Ea : DE^2 (16.) and Aa^2 is greater than Bb^2, therefore AE.Ea is greater than DE^2; and AE.Ea+EC^2 is greater than DE^2+EC^2; that is AC^2 is greater than DC^2, therefore, AC is greater than DC. Fig. 19.

By the same manner of reasoning it may be shewn, that because Bb^2 is less than Aa^2, BL.Lb+CL^2 is

Ellipse. less than DL^2+CL^2, that is BC^2 is less than DC^2, and BC less than DC.

PROP. XVIII.

If an ordinate be drawn to any diameter of an ellipse, the rectangle contained by the abscissæ is to the square of the semiordinate as the diameter to its parameter.

Fig. 20. Let DE be a semiordinate to the diameter Pp, let PG be the parameter of the diameter, and Qq the conjugate diameter: By Def. 15. $Pp : Qq :: Qq : PG$; therefore, $Pp : PG :: Pp^2 : Qq^2$ (2 Cor. 20. 6. E.), but $Pp^2 : Qq^2 :: PE.Ep : DE^2$ (16.); therefore, $PE.Ep : DE^2 :: Pp : PG$.

COR. 1. Let the parameter PG be perpendicular to the diameter Pp; join PG, and from E draw EM parallel to PG, meeting PG in M. The square of DE, the semiordinate, is equal to the rectangle contained by PE and EM.

For $PE.Ep : DE^2 :: Pp : PG$, and
$Pp : PG :: Ep : EM : PE.Ep : PE.EM$,
Therefore $DE^2 = PE.EM$.

SCHOLIUM.

If the rectangles PGLp, HGKM be completed, it will appear that ED^2 is equal to the rectangle MP, which rectangle is less than the rectangle KP contained by the abscissa PE, and parameter PG, by a rectangle KH similar, and similarly situated to LP, the rectangle contained by the diameter and its parameter. It was on account of the deficiency of the square of the ordinate from the rectangle contained by the abscissa and parameter, that Apollonius called the curve, to which the property belonged, an *Ellipse*.

PROP. XIX.

If from the vertices of two conjugate diameters of an ellipse, there be drawn ordinates to any third diameter, the square of the segment of that diameter intercepted between either ordinate and the centre, is equal to the rectangle contained by the segments between the other ordinate and the vertices of the same diameter.

Fig. 21. Let Pp, Qq be two conjugate diameters, and PE, QG semiordinates to any third diameter Aa, then $CG^2 = AE.Ea$; and $CE^2 = AG.Ga$. Draw the tangents PH, QK meeting Aa in H and K. The rectangles HC.CE and KC.CG are equal; for each is equal CA^2 (14.), therefore $HC : CK :: CG : CE$. But the triangles HPC, CQK are evidently similar (Cor. Def. 14.), and PE being parallel to QG, their bases CH, KC are similarly divided at E and G, therefore $HC : CK :: HE : CG$; wherefore $CG : CE :: HE : CG$, consequently $CG^2 = CE.EH =$ (Cor. 1. 14.) $AE.Ea$. In like manner it may be shewn, that $CE^2 = AG.Ga$.

COR. 1. Let Bb be the diameter that is conjugate to Aa; then Aa is to Bb, as CG to PE, or as CE to QG.

For $Aa^2 : Bb^2 :: AE.Ea$, or $CG^2 : PE^2$, therefore $Aa : Bb :: CG : PE$. In like manner $Aa : Bb :: CE : QG$.

COR. 2. The sum of the squares of CE, CG, the segments of the diameter to which the semiordinates PE, QG are drawn, is equal to the square of CA, the semidiameter.

For $CE^2 + CG^2 = CE^2 + AE.Ea = CA^2$.

COR. 3. The sum of the squares of any two conjugate diameters, is equal to the sum of the squares of the axes.

Let Aa, Bb be the axes, and Pp, Qq any two conjugate diameters; draw PE, QG perpendicular to Aa, and PL, QM perpendicular to Bb; then $CE^2 + CG^2 = CA^2$, and $CM^2 + CL^2$, or $GQ^2 + PE^2 = CB^2$; therefore $CE^2 + PE^2 + CG^2 + GQ^2 = CA^2 + CB^2$; that is (47. 1. E.), $CP^2 + CQ^2 = CA^2 + CB^2$, therefore $Pp^2 + Qq^2 = Aa^2 + Bb^2$.

PROP. XX.

If four straight lines be drawn touching an ellipse at the vertices of any two conjugate diameters, the parallelogram formed by these lines is equal to the rectangle contained by the transverse and conjugate axes.

Let Pp, Qq be any two conjugate diameters, the parallelogram VXYZ formed by tangents to the curve at their vertices, is equal to the rectangle contained by Aa, Bb the two axes. Produce Aa, one of the axes, to meet the tangent pY in N, join QN, and draw pI, QG perpendicular to Aa. Because $CN : CA :: CA : CI$ (14.), and $CA : CB :: CI : QG$ (1 Cor. 19.) ex æq. $CN : CB :: CA : QG$, therefore $CN.QG = CB.CA$. But $CN.QG =$ twice trian. CNQ = paral. $CpYQ$, therefore the parallelogram $CpYQ = CB.CA$, and taking the quadruple of these, the parallelogram VXYZ is equal to the rectangle contained by Aa and Bb. Fig. 21.

PROP. XXI.

If two tangents, at the vertices of any diameter of an ellipse, meet a third tangent, the rectangle contained by their segments, between the points of contact and the points of intersection, is equal to the square of the semi-diameter to which they are parallel. And the rectangle contained by the segments of the third tangent, between its point of contact and the parallel tangents, is equal to the square of the semi-diameter to which it is parallel.

Let PH, ph, tangents at the vertices of a diameter Pp, meet HDh, a tangent to the curve, at any point D in H and h. Let CQ be the semi-diameter, to which the tangents PH, ph are parallel, and CR that to which Hh is parallel, then $PH.ph = CQ^2$, and $DH.Dh = CR^2$. If the tangent HDh be parallel to Pp, the proposition is manifest. If it is not parallel, let it meet the semidiameters CP, CQ in L and K. Draw DE, RM parallel to CQ, and DG parallel to CP. Because $LP.Lp = LE.LC$ (2 Cor. 14.) $LP : LE :: LC : Lp$, and because PH, ED, CK, ph, are parallel, $PH : ED :: CK : ph$, wherefore $PH.ph = ED.CK$; but $ED.CK = CG.CK = CQ^2$ (14.), therefore $PH.ph = CQ^2$. Again, the triangles LED, CMR are evidently similar; and LE, LD similarly divided at P and H, also at p and h, therefore $PE : HD :: (LE : LD ::) CM : CR$, also $pE : hD :: (LE : LD) CM : CR$, hence taking the rectangles of the corresponding terms, $PE.pE : HD.hD :: CM^2 : CR^2$. But if CD be joined, the points D and R are evidently the vertices of two conjugate diameters (Cor. Def. 14.) and therefore $PE.pE = CM^2$ (19.), therefore $HD.hD = CR^2$. Fig. 22.

COR. The rectangle contained by LD and DK, the segments of a tangent intercepted between D the point of contact and Pp, Qq, any two conjugate diameters is equal to the square of CR, the semi-diameter to which the tangent is parallel. Let the parallel tangents PH, ph meet LK in H and h, and draw DE a semi-ordinate to Pp. Because of the parallels PH, ED, CK, ph, $LE : LD :: EP : DH$, and $EC : DK :: Ep : Dh$, therefore $LE.EC : LD.DK :: EP.Ep : DH.Dh$. But $LE.EC = EP.Ep$ (1. Cor. 14.), therefore $LD.DK = DH.Dh =$ (by this Prop.) CR^2.

Ellipse.

Prop. XXII.

Fig. 23. If two straight lines be drawn from the foci of an ellipse perpendicular to a tangent, straight lines drawn from the centre to the points in which they meet the tangent, will each be equal to half the transverse axis.

Let DPd be a tangent to the curve at P, and FD, fd perpendiculars to the tangent from the foci; the straight lines joining the points C, D, and C, d are each equal to AC, half the transverse axis. Join FP, fP, and produce FD, fP till they intersect in E. The triangles FDP, EDP, have the angles at D right angles, and the angles FPD, EPD equal (8.), and the side DP common to both, they are therefore equal, and consequently have ED=DF, and EP=PF, wherefore Ef=FP+Pf=Aa. Now, the straight lines FE, Ff being bisected at D and C, the line DC is parallel to Ef (2. 6. E.); and thus the triangles FfE, FCD are similar; therefore Ff : fE or Aa : : FC : CD; but FC is half of Ff, therefore CD is half of Aa. In like manner it may be shewn, that Cd is half of Aa.

Cor. If the diameter Qq be drawn parallel to the tangent Dd, it will cut off from PF, Pf, the segments PG, Pg, each equal to AC, half the transverse axis. For CdPG, CDPg are parallelograms, therefore PG=dC, and Pg=DC=AC.

Prop. XXIII.

The rectangle contained by perpendiculars drawn from the foci of an ellipse to a tangent, is equal to the square of half the conjugate axis.

Fig. 23. Let DPd be a tangent, and FD, fd, perpendiculars from the foci, the rectangle contained by FD and fd is equal to the square of CB, half the conjugate axis.

It is evident from the last proposition, that the points D, d are in the circumference of a circle, whose centre is the centre of the ellipse, and radius CA half the transverse axis; now FDd being a right angle, if dC be joined, the lines DF, dC, when produced, will meet at H, a point in the circumference (31. 3. E.); and since FC=fC, and CH=Cd, and the angles FCH, fCd are equal, FH is equal to fd, therefore DF.df=DF.FH =AF.Fa (35. 3. E.) =CB², (2. Cor. 3.)

Cor. If PF, Pf be drawn from the point of contact to the foci, the square of FD is a fourth proportional to fP, FP, and BC². For the lines fP, FP make equal angles with the tangent (8.), and fdP, FDP are right angles, therefore the triangles fPd, FPD are similar, and fP : FP : : (fd : FD : :) fd.FD or CB² : FD².

Prop. XXIV.

Fig. 24. If from C, the centre of an ellipse, a straight line CL be drawn perpendicular to a tangent LD, and from D, the point of contact, a perpendicular be drawn to the tangent, meeting the transverse axis in H, and the conjugate axis in h, the rectangle contained by CL and DH is equal to the square of CB, the semi-conjugate axis; and the rectangle contained by CL and Dh is equal to the square of CA, the semi-transverse axis.

Produce the axes to meet the tangent in M and m, and from D draw the semi-ordinates DE, De, which will be perpendicular to the axis.

The triangles DEH, CLm are evidently equiangular, therefore DH : DE : : Cm : CL, hence CL.DH=DE.Cm; but DE.Cm, or Ce.Cm=BC², therefore CL.DH=BC². In the same manner it is shewn, from the triangles Dhe, CLM, that CL.Dh=AC².

Cor. 1. If a perpendicular be drawn to a tangent at the point of contact, the segments, intercepted between the point of contact and the axes, are to each other reciprocally as the squares of the axes by which they are terminated.

For AC² : BC² : : CL.Dh : : CL.DH : : Dh : DH.

Cor. 2. If DF be drawn to either focus, and HK be drawn perpendicular to DF, the straight line DK shall be equal to half the parameter of the transverse axis. Draw CG parallel to the tangent at D, meeting DH in N, and DF in G. The triangles GDN, HDK are similar; therefore GD : DN : : HD : DK, and hence GD.DK=HD.DN. But GD=AC, (Cor. 22.) and ND=CL, therefore AC.DK=HD.CL= (by the Prop.) CB²; wherefore AC : BC : : BC : DK, hence DK is half the parameter of Aa, (Def. 15.)

Prop. XXV.

Let Aa, Bb be the transverse aud conjugate axes of an ellipse; from K, any point in the conjugate axis, let a straight line KH, which is equal to the sum or difference of the semi-axes CA, CB, be placed so as to meet the transverse axis in H, and in KH, produced beyond H, when KH is the difference of the semi-axis, let HD be taken equal to CB, the point D is in the ellipse. Fig. 25.

Draw DE perpendicular to Aa, and through C draw CG parallel to KD, meeting ED in G, then CG=KD =AC by construction; hence G is in the circumference of a circle, of which C is the centre, and CA the radius; and because the triangles CEG, HED are similar, GE : DE : : CG : HD : : CA : CB, therefore DE is a semiordinate, and D a point in the ellipse, (Cor. 5. 16.)

Scholium.

The instrument called the *trammels*, and likewise the *elliptical compasses*, which workmen use for describing elliptic curves, are constructed on the property of the curve demonstrated in this proposition.

Prop. XXVI. *Problem.*

An ellipse being given by position to find its axes.

Let ABab be the given ellipse, draw two parallel chords Hh, Kk, and bisect them at L and M; join LM, and produce it to meet the ellipse in P and p, then Pp is a diameter, (4. Cor. 13.) Bisect Pp in C, the point C is the centre of the ellipse (9.) Take D any point in the ellipse, and on C as a centre, with the distance CD describe a circle. If this circle fall wholly without the curve, then CD must be half the transverse axis; and if it fall wholly within the curve, then CD must be half the conjugate axis (17.) If the circle neither fall wholly without the curve nor within it, let the circle meet it again in d; join Dd, and bisect Dd in E, join CE, which produce, to meet the ellipse in A and a, then Aa will be one of the axes (5. Cor. 13.), for it is perpendicular to Dd (3. 3. E.), which is an ordinate to Aa. The other axes Bb will be found, by drawing a straight line through the centre perpendicular to Aa. Fig. 26.

SECTION III.

Of the Hyperbola.

Definitions.

1. Let F, f be two given points, and PQ, pq two straight lines between these points, equally distant from Fig. 27.

Hyperbola. C, the middle of the line joining them, and perpendicular to that line at P and p; and in the same line, let CA and Ca be taken in contrary directions, each a mean proportional between CF and CP; then, if a point D be conceived to move in the plane of the lines, in such a manner, that DF its distance from one of the given points, has to DE its distance from the given line adjacent to that point, the given ratio of CF to CA, and consequently so that Df its distance from the other given point has to De its distance from the other given line the same given ratio, (Sect. I. Prop. 1.) the point D will describe a curve line called an *Hyperbola.*

2. Each of the lines PQ, pq is called a *directrix.*

3. Each of the points F, f is called a *focus.*

4. The given ratio of CF to CA is called the *determining ratio.*

5. The point C is called the *centre* of the hyperbola.

Cor. to Def. 1. 3. 4. If Mm be drawn through F at right angles to Ff, and FM, Fm be taken, so that FM and Fm are each to FP in the determining ratio, the points M, m are in the hyperbola, and these are the only points in which the line Mm can meet the curve.

Def. 6. The straight line Aa is called the *transverse axis.*

7. The extremities of the transverse axis are called the *vertices.*

8. The distance of either focus from the centre is called the *eccentricity.*

Corollaries to Def. 1, 3, 4, 6.

1. The hyperbola passes through the extremities of the transverse axis. For since CA : CP : : CF : CA, therefore CF—CA : CA—CP : : CF : CA (19. 5. E.) that is, FA : AP : : CF : CA. Again, since Ca : CP : : CF : Ca, therefore, Ca+CF : CP+Ca : : CF : Ca, that is Fa : aP : : CF : Ca, or CA, therefore A and a are points in the hyperbola.

2. The distance between the foci has to the transverse axis, and the transverse axis has to the distance between the directrices, the determining ratio.

Prop. I.

Fig. 28. The difference between two straight lines drawn from any point D in the hyperbola to the foci is equal to the transverse axis.

$$\left.\begin{array}{l}\text{For } ED : DF :: Pp : Aa \\ \text{and } eD : Df :: Pp : Aa\end{array}\right\}\text{Cor. 2. to Def. 1. 3. 4. 6.}$$

$$\text{therefore } eD—ED : Df—DF :: Pp : Aa.$$

$$\text{But } eD—ED = Pp, \text{ therefore } Df—DF = Aa.$$

Scholium.

This property of the hyperbola affords a good definition of the curve, and has been employed as such by many writers on conics. The following mechanical description is also derived from it: Let one end of a string be fastened at F, (Fig. 28.) either of the foci, and the other to E, the extremity of a ruler fDE, and let the difference between the length of the string and the length of the ruler be equal to Aa, the transverse axis. Let the other end of the ruler be fixed at the other focus f, and let it revolve about f as a centre in the plane of the figure, while the string is stretched by means of a pin at D, so that the part of it between E and D is applied close to the edge of the ruler. By the revolution of the ruler, the lines Df, DF will manifestly be equally increased, and therefore their difference will always be the same quantity, viz. the line Aa; hence the point D will describe a branch of a hyperbola, of which Aa is the transverse axis, and F, f the foci. The other branch may be described, by fixing the end of the ruler to the other focus.

Hyperbola.

Prop. II.

Let FM be a perpendicular to the transverse axis at either focus, which meets the hyperbola at M, and let a circle be described on F as a centre, with FM as a radius; then, if from any point in the curve, a line DF be drawn to, or through the focus, meeting the circle in I, so that the points D, I may be on contrary sides, or the same side of the focus, according as the focus and the point D are on the same side or contrary sides of the directrix, and let IN be perpendicular to the axis, then the rectangle contained by the lines FD.PN is equal to the constant rectangle PF.FM. Fig. 29. No. 1, 2.

Join EF and PI, and because FM or FI : FP : : FD : DE (Cor. to Def. 1—4.), and (from the position of the lines) the angles FDE, IFP are equal (29. 1. E.) the triangles FDE, IFP are similar (6. 6. E.), and the angles DFE, FIP equal; hence FE is parallel to PI (2. 1. E.): Therefore the triangles FPE, PNI having the angles at F and P equal (29. 1. E.), and the angles at P and N being right angles, the triangles are equiangular: And because FD : FE : : IF : IP, and FE : FP : : IP : PN, ex æq. FD : FP : : IF or FM : PN (22. 5. E.), and FD.PN=FP.FM.

Cor. Hence it is evident how the point in which a straight line drawn from the focus meets the curve may be found, viz. by taking FD a fourth proportional to PN, FM and FP.

Scholium.

From this proposition we may acquire a correct notion of the figure of the curve, by considering the changes which take place in the magnitude of the line FD, while the angle PFD increases. Let us suppose the line FD to come to the position FA on the same side of the directrix as the focus (Fig. 29. No. 1.), then the point N will recede to L the extremity of the diameter farthest from P; and as PN will then be the greatest possible, FD will be the least. Suppose now the line FD to depart from the position FA, and to revolve about F, then the angle DFP increasing, the point N will approach to P; and as the rectangle FD.PN has always the same magnitude, the line FD must increase. Now, the determining ratio being a ratio of majority, and FM to FP in that ratio (Cor. to Def. 1—4.), FP must be less than FM; therefore P falls within the circle: hence it follows that PN may become less, and consequently FD greater than any assignable quantity. If we suppose the point I to arrive at last at K, one of the intersections of the directrix and circle, then the line PN altogether vanishes; therefore, corresponding to this position, there can be no intersection of the curve and the revolving line FD. By supposing the line FD to depart from the position FA, and to revolve in the contrary direction, or from A towards m, it will appear that it increases continually, until FI, its prolongation, arrive at the position Fk, (k being the other intersection of the directrix and circle), and here the point in which the line meets the hyperbola again has no existence. Fig. 29. No. 1.

If we now suppose the line FD (Fig. 29. No. 2.) which is drawn from the focus F to the part of the hyperbola on the other side of the directrices, to come to the position Fa, and departing from thence, to re- Fig. 29. No. 2.

volve about F, first on one, and then on the other side of the axis, until in the one case it come to the position F k, and in the other to FK, it will appear that PN, one side of the constant rectangle FD.PN, will pass through all gradations of magnitude from PL′ its greatest value, until it at last vanish, and consequently that PD the other side will increase continually, from P a its least value, until it exceed any assignable quantity. Moreover, the hyperbola does not meet either of the lines FK, Fk.

We may conceive the very same construction to be made at the other focus f, as has been made at F, in both figures; so that, upon the whole, we may draw the following conclusions.

1. The hyperbola consists of two parts entirely separate from each other, and having the directrices between them; and each is bent at the vertex into two branches, which lie on opposite sides of the transverse axis produced both ways.

2. If a circle be described on F, either focus, as stated in the proposition, and straight lines KFX, kFx be drawn from its intersections with the directrix through the focus, and produced indefinitely, the part of the hyperbola which is on the same side of the directrix will lie entirely in the space bounded by the directrix and the lines FX, Fx, and it will not meet these lines, and the other part will be entirely contained in the angle yFY, formed by these lines produced the contrary way.

3. The vertices are the points of the curve nearest to either focus, and of lines drawn from a focus to the curve, those nearer the vertex are less than those more remote. And the curve goes off indefinitely from both foci, and from the prolongation of the axis.

4. Lines drawn from a focus to the curve, so as to make equal angles with the axes on either side of it, are equal to one another.

Definitions.

9. The two parts of an hyperbola, which lie on opposite sides of the centre, are termed opposite *branches of the hyperbola.*

Fig. 27. 10. If a straight line Bb be perpendicular to the transverse axis at the centre C, and BA, b A, the distance of its extremities from either vertex, be equal to FC the eccentricity; the line B b is called the *Conjugate axis.*

Note. The conjugate axis of the hyperbola is not limited in its magnitude by the figure of the curve, as is that of the ellipse; it is an artificial axis introduced conventionally, in order to preserve the analogy between certain properties of the two curves.

Cor. to Def. 10. The conjugate axis is bisected at the centre of the hyperbola.

Prop. III.

The square of the semiconjugate axis is equal to the rectangle contained by the distances of either focus from the vertices of the transverse axis.

Fig. 27. For $AB^2 = AC^2 + CB^2$ (47.1.E.) and FC^2 $(=AB^2)$ $=AC^2 + FA.Af$ (5. 2. E.) therefore $BC^2 = FA.Af$.

Cor. Let P be the point in which the directrix belonging to the focus F meets the axis; then, $BC^2 = PF.FC$. For $FC^2 = PF.FC + PC.FC$ (2. 2. E.) $= PF.FC + AC^2$, because $AC^2 = PC.CF$ (Def. 1.); but FC^2 or $AB^2 = CB^2 + AC^2$, therefore $PF.FC = CB^2$.

Definition.

11. A straight line which meets the hyperbola, and being produced does not cut it, is said to *touch* the curve, and is called a *Tangent.*

Prop. IV. *Problem.*

Having given the transverse axis, and a focus, and consequently its directrix, to find the points in which a straight line given by position, perpendicular to the axis, meets the hyperbola.

Let Aa be the transverse axis, F either focus, PQ the directrix, and L l the line given by position, which meets the axis in G. Draw FM perpendicular to the axis, meeting the curve in M; draw MPL, meeting the line, given by position in L. On F as a centre, with GL as a radius, describe a circle, meeting LG in D and d; and these will be two points in the curve. Fig. 30.

For join FD, Fd, and draw DE, de perpendicular to the directrix; and because the triangles PGL, PFM are similar, GL : GP : : MF : FP, or, since ED, ed are each equal to PG, and that FD and Fd are each equal to LG, FD : DE, also Fd : de : : MF : FP, that is, (Cor. to Def. 1. 3. 4.) in the determining ratio; therefore D and d are points in the hyperbola, (Def. 1.)

It appears that the problem can be resolved only when GL=FD is greater than GF. To determine the limits within which this happens, draw AH, a h perpendicular to the axis, meeting PL in H and h; and join FH, Fh. Then, by similar triangles, PF : FM : : PA : AH : : Pa : ah, but PF : FM : : PA : AF : : Pa : aF (Def. 1.) therefore AH=AF and ah=a F. Now let GL meet either of the lines FH, Fh in N, then GN=GF; but when G is any point in the axis Aa produced either way, GN or GF is less than GL; when it is at A or a, then GN or GF=GL, and when it is between A and a, then GN or GF is greater than GL; therefore the problem will be possible, only when the line L l meets the tranverse axis A a produced.

Cor. 1. Every straight line perpendicular to the transverse axis, at any point in the axis, produced either way, meets the hyperbola in two points and no more; at either extremity of the axis it meets the curve in one point only, and at any point between the extremities of the axis, it falls entirely without both branches of the hyperbole.

Cor. 2. Every chord perpendicular to the transverse axis is bisected by the axis.

Cor. 3. A perpendicular to the axis at either of its extremities is a tangent.

Cor. 4. The transverse axis divides the hyperbola into parts exactly alike.

Prob. V. *Problem.*

The transverse axis, and a focus, and consequently its directrix, being given to find the points in which a straight line given by position, parallel to the axis, meets the hyperbola.

Let EH, the line given by position, meet the directrix in E, and the conjugate axis, or that axis produced in H; draw FE from the focus, meeting HC in G. On G as a centre, with a radius, which is a mean proportional between EG and GF, describe a circle, meeting EH in D and d; and these will be two points in the hyperbola. Fig. 31.

Join DF, Df, and because EG : GD : : GD : GF and

Hyperbola.

that the angle at G is common to the triangles EGD, DGF; these triangles are similar (6. 6. E.) and ED : DF : : EG : GD, therefore $ED^2 : DF^2 :: EG^2 : GD^2$; but $EG^2 : GD^2 :: EG : GF$ (2. Cor. 20. 6. E.) that is, as PC to CF (2. 6. E.) and $PC : CF :: AC^2 : CF^2$ (Def. 1. and Cor. 2. 20. 6. E.) therefore $ED^2 : DF^2 :: AC^2 : CF^2$ and $ED : DF :: AC : CF$; hence D is a point in the hyperbola (Def. 1.) and in like manner it may be shewn, that d is a point in the hyperbola.

And because the point E must, from the position of the directrix, always fall between F and G, therefore DG, the mean proportional between GE and GF, will always be greater than GE, and consequently much greater than GH, the perpendicular from G on D d; hence whatever be the position of the given line EH, provided that it be parallel to the axis, the circle will always cut it in two points, so that in this case there is not any limitation to the possibility of constructing the problem.

Cor. 1. Every straight line parallel to the transverse axis meets the opposite branches of the hyperbola each in one point and no more.

Cor. 2. Every straight line parallel to the transverse axis, and terminating on opposite branches of the hyperbola, is bisected by the conjugate axis, or that axis produced.

Cor. 3. The two branches of the hyperbola are perfectly alike, so that if applied one on the other they would coincide.

Prop. VI.

Fig. 32.

If from any point Q in the directrix a straight line be drawn to meet the hyperbola in D, and LF l a parallel to the directrix passing through the focus in H, and if another straight line be drawn to D through F, and a perpendicular QK be drawn to FD; the lines FH, QK have to each other the determining ratio.

Draw DE perpendicular to the directrix, and let DF meet it in I. The triangles DHF, DQI are evidently equiangular (29. 1. E.) and the triangles QIK DIE are also equiangular, for the angles at K and E are right angles, and the angle at I is common to both, therefore (4. 6. E.) FH : FD (: : QI : ID) : : QK : DE, and by alternation FH : QK : : FD : DE, that is in the determining ratio.

Cor. 1. If a straight line QH meet the directrix in Q, and the parallel Ll in H; and if KF, a line which is not parallel to QH, have such a position that FH has to QK (the distance of KF from Q) the determining ratio, the lines QH, KF shall meet at a point D in the hyperbola: For then FD : DE : : FH : QK, that is in the determining ratio; therefore D is in the hyperbola (Def. 1.)

Cor. 2. If QF be drawn to the focus, and in FH, the parallel to the directrix, FL and Fl be taken in contrary directions, each to FQ in the determining ratio, then every straight line which meets the hyperbola will either pass between, or through the points L, l; For since, by hypothesis, FQ : FL : : KQ : FH, and since KQ, cannot exceed FQ; therefore FH cannot exceed FL.

Cor. 3. Any straight line drawn from Q to intersect the parallel Ll beyond the limits L, l falls entirely without both branches of the hyperbola.

Prop. VII. *Problem.*

Having given a focus, its directrix, and the determining ratio, to find the points in which a straight line given by position, and not parallel to the directrix, meets the hyperbola.

Hyperbola.

Fig. 33. Nos. 1, 2.

Case 1. Let XY (Fig. 33. No. 1. and No. 2.) the line given by position, pass through F the focus: draw FQ perpendicular to XY, meeting the directrix in Q, and in LF l, the line passing through the focus parallel to the directrix, take FL and F l each to FQ in the determining ratio, and join QL and Q l; then, if neither of the angles FQL, FQl be a right angle, as in Fig. 33. No. 1, the lines QL, Q l will meet XY in two points D, d, which will be points in the curve (as is evident from Cor. 1. Prop. VI.) But if one of the angles FQ l be a right angle, as in Fig. 33. No. 2. there will be only one intersection D. To determine the position which the line XY must have, in order that this may happen, produce it to meet the directrix in V, and draw FP perpendicular to the directrix: The triangle FPV being similar to VFQ or FQ l (8. 6. E.) we have FV : FP : : F l : FQ, that is in the determining ratio. Let M be an intersection of L l and the curve, and FM will have to FP the same ratio (Cor. to Def. 1—4) therefore FV = FM, and V is the point in which a circle described on F as a centre, with FM as a radius, meets the directrix.

Fig. 34. Nos. 1, 2.

Case 2. Next let the line given by position meet the parallel to the directrix in H, (Fig. 34. No. 1. and 2.) so that QF being drawn to the focus, and FL and F l taken to FQ in the determining ratio, it may fall between F and either of the points L, l. In QF take QN, so that HF may have to QN the determining ratio, that is, the ratio of FL to QF, then it is manifest that QN is less than QF. On Q as a centre, with QN as a radius, describe a circle, and draw FK, F k tangents to it, then if neither of these is parallel to the line QH, as in Fig. 34. No. 1. they will meet it in two points D, d, which will be points in the hyperbola, as is evident from Prop. 6. Cor. 1. But if, as in Fig. 34. No. 2. one of the tangents F k be parallel to the line QH, there will be only one intersection D. To determine the position which the line QH ought to have, that this may happen, let F k meet the directrix in V, and let FP be perpendicular to the directrix. The triangles FPV, QV k are evidently equiangular, therefore FV : FP : : VQ or FH : Q k, that is as FM to FP (Cor. to Def. 1—4.) hence FM = FV; and V is that point in which the directrix meets the circumference of a circle, of which FM is the radius and HQ, the line given by position, is parallel to FV.

Case 3. Lastly, let the line given by position, and which meets the directrix in Q, pass through one of the points l (Fig. 34. No. 1.) which are so taken that F l or FL has to FQ the determining ratio: Draw FD′ perpendicular to FQ, and if it is not parallel to Q l it will meet Q l in some point D′ which will be a point in the hyperbola (1. Cor. Prop. 6.) But if, (as in Fig. 3. No. 2.), FQ l is a right angle, FD will be parallel to Q l, and so the line Q l will not meet the curve at all. To determine the position of Q in this case, draw FV perpendicular to FQ meeting the directrix in V. Then the triangle FPV is similar to VFQ or FQ l (8. 6. E.) therefore FV : FP : : F l: FQ that is in the determining ratio; therefore FV = FM, and so V is the intersection of the directrix and a circle whose radius is FM, and QL is parallel to FV.

Cor. 1. The points L, l being determined as in the second and third cases, (Fig. 34. No. 1. and No. 2.), any straight line drawn from Q to pass between them, will either cut the hyperbola in one point only, or in two points, and no more. For the number of points in which the line cuts the curve must be the same as the number of tangents to the circle KN k which meet that line, as was shewn with respect to the ellipse (Sect. II. Prop. 7.)

Fig. 34. No. 1. Cor. 2. If from D d (Fig. 34. No. 1.) the points in which a straight line meets an hyperbola, straight lines DF, d F be drawn to either focus, these make equal angles with FQ, a straight line drawn from the focus to the point in which D d meets the directrix. For the triangles FQK, FQ k are in all respects equal (47. 1. E.) therefore the angles QFK, QF k are equal.

Cor. 3. The points L, l (Fig. 33. No. 2.) and the lines FV, F v being determined as in Case 3. If a line be drawn from Q through L or l, provided it be not parallel to one of the lines FV, F v, that line will be a tangent to the hyperbola.

Cor. 4. If any line whatever meet a hyperbola, it will either cut it in one point only, or in two points and no more, or it will touch it.

Fig. 35. Cor. 5. If two straight lines FD, FQ (Fig. 35.) which contain a right angle at the focus, meet the curve and the directrix in D and Q; the straight lines which join these points is a tangent to the hyperbola at D, and only one tangent can be drawn at that point.

It is evident from the third case, that QD is a tangent; and to prove that there is no other at D, draw any other line DQ′ meeting the directrix in Q′, and the parallel to the directrix in H; take FL to QF in the determining ratio, and draw Q′K perpendicular to FD: and because FH has to Q′K, and also FL has to QF the determining ratio; and Q′K is less than QF, therefore FH is less than FL; hence the line QH cuts the hyperbola (Cor. 1. of this Prop.) therefore no line besides DQ can be a tangent to the curve at D.

Cor. 6. Tangents DQ, dQ (Fig. 33. No. 1.) at the extremities of any focal chord, and a perpendicular to that chord at the focus, meet at the same point in the directrix.

Prop. VIII.

A tangent to the hyperbola makes equal angles with straight lines drawn from the point of contact to the foci.

Fig. 36. If the tangent be at either extremity of the transverse axis, the proposition is evidently true (3. Cor. 4.) In any other case, let it touch the curve at D, and meet the directrices in Q and q; draw DF, Df, to the foci, and DE e perpendicular to the directrices; and join FQ, f q. The triangles DEQ, D e q are manifestly equiangular; therefore DQ : DE : : D q : D e (4. 6. E.) but DE : DF : : D e : Df (Def. 1.) therefore ex æq. (22. 5. E.) DQ : DF : : D q : D f; hence it appears, that the triangles DFQ, Df q, which have the angles at F, f right angles (5. Cor. 7.) have the sides about one of their acute angles proportionals, therefore they are equiangular (7. 6. E.) and have the angles FDQ, fD q equal.

Definition.

12. A straight line passing through the centre and terminating both ways in an hyperbola, is called a *Transverse Diameter*. It is also sometimes called simply a *Diameter.*

Prop. IX.

Every diameter is bisected at the centre.

From D any point in the hyperbola draw the straight line DH d' parallel to the transverse axis, meeting the conjugate axis at H, and the opposite branch in d'; and draw the chord d' h d perpendicular to the transverse axis at h, and join H h, DC, dC. Then, DH = H d' (2. Cor. 5.) = C h (34. 1. E.) and HC = d' h = h d; hence the figures DH hC, HC d h are parallelograms (33. and 34. 1. E.) and since (29. 1. E.) the angles DCh and ChH, that is the angles DCh and hCd, are equal to two right angles, the line DC and Cd lie in the same straight line (14. 1. E.) or DC d is a diameter; moreover DC = H h = Cd, therefore the diameter DC d is bisected at C. Fig. 37.

Prop. X.

The tangents at the vertices of any transverse diameter of an hyperbola are parallel.

Let D d be a diameter, HD, h d tangents at its vertices; draw straight lines from D and d to F, and f the foci. The triangles FCD, fC d, having FC = fC, CD = Cd (9.) and the angles at C equal, are in all respects equal, and because the angle FDC is equal to C$d$$f$, FD is parallel to $f$$d$ (27. 1. E.), therefore Df is equal and parallel to F d (33. 1. E.); thus FD$f$$d$ is a parallelogram, of which the opposite angles D and d are equal (34. 1. E.); now the angles FDH, $f$$d$ h are the halves of these angles (8.); therefore the angles FDH, $f$$d$$h$, and hence CDH and C$d$$h$ are also equal, and consequently HD is parallel to h d. Fig. 38.

Cor. 1. If tangents be drawn to an hyperbola at the vertices of a transverse diameter, straight lines drawn from either focus to the points of contact, make equal angles with these tangents. For the angle Fd h is equal to FDH.

Cor. 2. The transverse axis is the only diameter which is perpendicular to tangents at its vertices. For let D d be any other diameter, the angle CDH is less than CDF, that is, less than the half of FDf; therefore CDH is less than a right angle.

Prop. XI.

A straight line drawn from either focus of an hyperbola to the intersection of two tangents to the curve will make equal angles with straight lines drawn from the same focus to the points of contact.

Let HD, H d be tangents to an hyperbola at the points D, d; let a straight line be drawn from H, their intersection to F, either of the foci; and let FD, F d be drawn to the points of contact; the lines DF, d F make equal angles with HF. Draw Df, df, and Hf to the other focus. In DF, d F take DK = Df, and d k = df; join HK, Hk, and let fK, $f$$k$ be drawn meeting the tangents in G and g. The triangles fDH, KDH have Df = DK, by construction, and DH common to both, also the angle fDH equal to KDH, (8.) therefore fH = KH. In like manner it may be shewn that fH is equal k H, therefore HK is equal to H k: now, F K is equal to F k, for each is equal to the difference between FD and fD, or F d and $f$$d$, that is, to the transverse axis; therefore the triangles FKH, F k H are in all respects equal, and hence the angle KFH is equal to k FH, therefore DF and d F make equal angles with HF. Fig. 39. Nos. 1, 2.

Cor. 1. Perpendiculars HI, H i drawn from the intersection of two tangents DH, d H to straight lines drawn from either focus through the points of contact are equal; for HI, Hi, perpendiculars to FD, F d, are manifestly equal (26. 1. E.)

Hyperbola.

COR. 2. Straight lines drawn from the intersection of any two tangents to the foci make equal angles with those tangents.

For produce FH to O any distance; and because the angles FHK, FHk are equal, the angles OHK, OHk are equal: but $\text{OHK}=\text{OH}f+2f\text{HD}$ and $\text{OH}k=k\text{H}g+\text{OH}g=f\text{H}g+\text{OH}g=\text{OH}f+2\,\text{OH}g$, therefore $\text{OH}f+2f\text{HD}=\text{OH}f+2\text{OH}g$; hence $2f\text{HD}=2\,\text{OH}g$ and $f\text{HD}=\text{OH}g=\text{OH}d$ (in Fig. 39. No 1.) or $f\text{HD}=\text{FH}d$ (in Fig. 39. No. 2.)

PROP. XII.

If there be two tangents at the extremities of a chord, and a third be parallel to the chord, the part of this tangent intercepted between the other two is bisected at the point of contact.

Fig. 40. Let HD, Hd be tangents at the extremities of the chord Dd, and KPk another tangent parallel to the chord, meeting the others in K and k; the line Kk is bisected at P the point of contact. From the points of contact D, P, d draw lines to F either of the foci, and from the intersection of each two tangents, draw perpendiculars to straight lines drawn from the focus through their points of contact; that is, draw HI, Hi perpendicular to FD, Fd and KM, Km perpendicular to FD and FP; and kN, kn perpendicular to Fd and FP. The triangles DHI, DKM are manifestly equiangular, as also $d\text{H}i$, $dk\text{N}$; therefore, DH : DK : : HI : KM; and dH : dk : : Hi : kN, but Kk being parallel to Dd, DH : DK : : dH : dk (2. 6. E.); therefore HI : KM : : Hi : kN, now HI = Hi (1. Cor. 11.) therefore KM = kN; but KM = Km, and kN = kn (1. Cor. 11.) therefore Km = Kn; and since we have manifestly Km : kn : : KP : kP (4. 6. E.) therefore KP=kp.

Definitions.

13. Any chord not passing through the centre which is bisected by a diameter, is called an *Ordinate* to that *diameter*.

14. The segments into which an ordinate divides a diameter are called *Abscissæ*.

LEMMA.

Fig. 41. Let HK$'k'$ be a triangle, having its base K$'k'$ bisected at p; and let Kk, any straight line parallel to the base, and terminated by the sides produced, be bisected at P, then P, p, the points of bisection, and H, the vertex of the triangle, are in a straight line, which bisects Dd any other straight line parallel to Kk.

Join HP, Hp. The triangles KHk, and K$'$Hk' being similar, and Kk, K$'k'$ similarly divided at P and p, we have HK : HK$'$ (: : Kk : K$'k'$) : : KP : K$'p$; now the angles at K and K$'$ are equal, therefore the triangles HKP, HK$'p$ are similar; and the angle PHK is equal to pHK$'$, and the sum of PHK and pHK is equal to the sum of pHK$'$ and pHK, that is to two right angles (13. 1. E.) therefore HP, Hp lie in the same straight line (14. 1. E.)

Again, let Dd meet HP in E, then KP : DE (: : PH : EH) : : Pk : Ed, but KP = Pk; therefore DE=Ed.

PROP. XIII.

Any chord not passing through the centre, but parallel to a tangent, is bisected by the diameter which passes through the point of contact, or it is an ordinate to that diameter.

The chord Dd, which is parallel to Kk a tangent at P, is bisected at E by the diameter Pp. Draw K$'pk'$ a tangent at p, the other end of the diameter, and DH, dH tangents at D, d, the extremities of the chord meeting the other tangents in K, k, and K$'$, k'. Then KPk and K$'pk'$ are bisected at P and p (12.) therefore the diameter Pp when produced must pass through H and bisect Dd, which is parallel to Kk or K$'k'$, in E (Lemma.) Fig. 42.

COR. 1. Straight lines which touch an hyperbola at the extremities of an ordinate to any transverse diameter, intersect each other in that diameter.

COR. 2. Every ordinate to a transverse diameter is parallel to a tangent at its vertex. For if not, let a tangent be drawn parallel to the ordinate, then the diameter drawn through the point of contact would bisect the ordinate, and then the same line would be bisected in two different points, which is absurd.

COR. 3. All the ordinates to the same transverse diameter are parallel to each other.

COR. 4. A straight line that bisects two parallel chords, and terminates in the opposite branches, is a transverse diameter.

COR. 5. The ordinates to the transverse axis are perpendicular to it, and no other transverse diameter has its ordinates perpendicular to it. This follows from Cor. 3. to 4. and Cor. 2. to 10.

PROP. XIV.

If a tangent to an hyperbola meet a transverse diameter, and from the point of contact an ordinate be drawn to that diameter, the semi-diameter will be a mean proportional between the segments of the diameter intercepted between the centre and the ordinate, and between the centre and the tangent.

Let DH, a tangent to the curve at D, meet the diameter Pp in H; and let DEd be an ordinate to that diameter; then CE : CP : : CP : CH. Through P and p, the vertices of the diameter, draw the tangents PK, pK$'$, meeting DH in K and K$'$: draw PF, pF, DF to either of the foci, and draw KM, Km perpendicular to FP and FD, and K$'$N, K$'n$ perpendicular to Fp, FD. The triangles PKM, pK$'$N are equiangular, for the angles at M and N are right angles, and the angles MPK, NpK$'$ are equal (1. Cor. 10.), therefore PK : pK$'$: : KM : K$'$N (4. 6. E.) : : Km : K$'n$ (1. Cor. 11.), but the triangles KmD, K$'n$D being manifestly equiangular, Km : K$'n$: : KD, K$'$D, therefore PK : pK$'$: : KD : K$'$D. But because of the parallel lines KP, DE, K$'p$, we have PK : pK$'$: : PH : pH, and KD : K$'$D : : PE : pE, therefore PH : pH : : PE : pE. Take CG= CE, then pG=PE, and (Cor. Prop. D. 5. E.) PH : Pp : : PE : EG, and taking the halves of the consequents, PH : PC : : PE : EC : hence by division HC : PC : : PC : EC. Fig. 42.

COR 1. The rectangle contained by PE and Ep is equal to the rectangle contained by HE and CE. For $\text{CP}^2=\text{HC.CE}=\text{EC}^2-\text{HE.EC}$ (2. 2. E.), also $\text{CP}^2=\text{EC}^2-\text{PE.E}p$ (6. 2. E.), therefore $\text{EC}^2-\text{HE.EC}=\text{EC}^2-\text{PE.E}p$, and $\text{HE.EC}=\text{PE.E}p$.

COR. 2. The rectangle contained by PH and Hp is equal to the rectangle contained by HE and HC.

For $\text{HC}^2=\text{CP}^2-\text{PH.H}p$ (5. 2. E.) also $\text{HC}^2=\text{EC.HC}-\text{EH.HC}=\text{CP}^2-\text{EH.HC}$ (3. 2. E. and by the Prop.), therefore $\text{CP}^2-\text{PH.H}p=\text{CP}^2-\text{EH.HC}$, and $\text{PH.H}p=\text{EH.HC}$.

Hyperbola.

Prop. XV.

If a tangent to an hyperbola meet the conjugate axis, and from the points of contact a perpendicular be drawn to that axis, the semi-axis will be a mean proportional between the segments of the axis intercepted between the centre and the perpendicular, and between the centre and the tangent.

Fig. 43. Let DH, a tangent to the hyperbola at D, meet the conjugate axis B*b* in H, and let DG be perpendicular to that axis, then CG : CB : : CB : CH.

Let DH meet the transverse axis in K, draw DE perpendicular to that axis, draw DF, D*f* to the foci, and describe a circle about the triangle D*f*F : the conjugate axis will evidently pass through the centre of the circle, and because the angle FD*f* is bisected by the tangent DK, the line DK will pass through one extremity of that diameter which cuts F*f* at right angles; therefore the circle passes through H. Draw DL to the other extremity of the diameter. The triangles LGD, KCH are similar, for each is similar to the right-angled triangle LDH, therefore LG : GD (=CE) : : CK : CH; hence $LG.CH = CE.CK = CA^2$ (by last Prop.) Now $LC.CH = CF^2$ (35. 3. E.) therefore $LC.CH - LG.CH = CF^2 - CA^2$, that is, $CG.CH = CB^2$ (Def. 10.) wherefore CG : CB : : CB : CH.

Definition.

Fig. 44. 15. If through A, one of the vertices of the transverse axis, a straight line HA*h* be drawn, equal and parallel to B*b*, the conjugate axis, and bisected at A by the transverse axis, the straight lines CHM, C*h m*, drawn through the centre and the extremities of that parallel, are called *Asymptotes.*

Cor. 1. The asymptotes are common to both branches of the hyperbola. Through *a*, the other extremity of the axis, draw H′*ah*′, parallel to B*b*, and meeting the asymptotes of the branch DAD in H′ and *h*′. Because *a*C is equal to AC, *a*H′ is equal to A*h*, or to BC; also *ah*′ is equal to AH, or to BC; hence, by the definition, CH′ and C*h*′ are asymptotes to the opposite branch *d a d*.

Cor. 2. The asymptotes are diagonals of a rectangle formed by drawing perpendiculars to the axes at their vertices. For the lines AH, CB, *a*H′ being equal and parallel, the points H, B, H′ are in a straight line passing through B parallel to A*a*; the same is true of the points *h*, *h*, *h*′.

Prop. XVI.

The asymptotes do not meet the hyperbola; and if from any point in the curve a straight line be drawn parallel to the conjugate axis, and terminated by the asymptotes, the rectangle contained by its segments from that point is equal to the square of half that axis.

Fig. 45. Through D, any point in the hyperbola, draw a straight line parallel to the conjugate axis, meeting the transverse axis in E, and the asymptotes in M and *m*; the points M and *m* shall be without the hyperbola, and the rectangle MD.D*m* is equal to the square of BC. Draw DG perpendicular to B*b*, the conjugate axis: let a tangent to the curve at D meet the transverse and conjugate axis in K and L, and let a perpendicular at the vertex A meet the asymptote in H. Because DK is a tangent, and DE an ordinate to the axis, CA is a mean proportional between CK and CE (14.), and therefore $CK : CE : : CA^2 : CE^2$ (2. Cor. 20. 6. E.) But CK : CE : : LC : LG, and $CA^2 : CE^2 : : AH^2 : EM^2$, therefore $LC : LG : : AH^2 : EM^2$. Again, CB being a mean proportional between CL and CG (15.), $LC : CG : : CB^2 : CG^2$, and therefore $LC : LG : : CB^2 : CB^2 + CG^2$ or $CB^2 + ED^2$; wherefore $AH^2 : EM^2 : : CB^2 : CB^2 + ED^2$. Now $AH^2 = CB^2$ (Def. 15.) therefore $EM^2 = CB^2 + ED^2$, consequently EM^2 is greater than ED^2, and EM greater than ED, therefore M is without the hyperbola. In like manner it appears, that *m* is without the hyperbola, therefore every point in both the asymptotes is without the hyperbola. Again, the straight line M*m*, terminated by the asymptotes, being manifestly bisected by the axis at E, $ME^2 = MD.Dm + DE^2$; but it has been shewn that $ME^2 = BC^2 + DE^2$, therefore $MD.Dm = BC^2$.

Cor. 1. Hence, if in a straight line M*m*, terminated by the asymptotes, and parallel to the conjugate axis, there be taken a point D such, that the rectangle MD.D*m* is equal to the square of that axis, the point D is in the hyperbola.

Cor. 2. If straight lines MD*m*, NR*n* be drawn through D and R, any points in the same branch, or opposite branches of the hyperbola, parallel to the conjugate axis, and meeting the asymptotes in M, *m*, and N, *n*, the rectangles MD.D*m*, NR.R*n* are equal.

Prop. XVII.

The hyperbola, and its asymptote when produced, continually approach to each other, and the distance between them becomes less than any given line.

Take two points E and O in the transverse axis produced, and through these points draw straight lines parallel to the conjugate axis, meeting the hyperbola in D, R, and the asymptotes in M, *m*, and N, *n*. Because NO^2 is greater than ME^2, and $NR.Rn = MD.Dm$ (2. Cor. 16.), therefore $NO^2 - NR.Rn$ is greater than $ME^2 - MD.Dm$, that is, RO^2 is greater than DE^2, and RO is greater than DE; now O*n* is greater than E*m*, therefore R*n* is greater than D*m*, and since R*n* : D*m* : : DM : RN (2. Cor. 16.), DM is greater than RN, therefore the point R is nearer to the asymptote than D; that is, the hyperbola when produced approaches to the asymptote. Let S be any line less than half the conjugate axis, then because D*m*, a straight line drawn from a point in the hyperbola, parallel to the conjugate axis, and terminated by the asymptote on the other side of the transverse axis, may evidently be of any magnitude greater than A*h*, which is equal to half the conjugate axis, D*m* may be a third proportional to S and BC; and since D*m* is also a third proportional to DM, (the segment between D and the other asymptote), and BC, DM may be equal to S; but the distance of D from the asymptote is less then DM; therefore that distance may become less than S; and consequently less than any given line. Fig. 45.

Cor. Every straight line passing through the centre, within those angles contained by the asymptotes through which the transverse axis passes, meets the hyperbola, and therefore is a transverse diameter; and every straight line passing through the centre within the adjacent angles falls entirely without the hyperbola.

Scholium.

The name asymptote (*non concurrentes*) has been given to the line CH, C*h*, because of the property they have of continually approaching to the hyperbola without meeting it, as has been proved in this Proposition.

Hyperbola.

Prop. XVIII.

If from two points in the same branch, or opposite branches of an hyperbola, two parallel straight lines be drawn to meet the asymptotes, the rectangles contained by their segments between the points and the asymptotes are equal.

Fig. 46. Nos. 1, 2. Let D and G be two points in the same branch, or in opposite branches of the hyperbola, and let parallel lines EDe, HGh be drawn to meet the asymptotes in E and e, and H, h; the rectangles $ED.De$, $HG.Gh$ are equal. Through D and G draw straight lines parallel to the conjugate axis, meeting the asymptotes in the points L, l, and M, m. The triangles HGM, EDL are similar; as also the triangles hGm, eDl; therefore $DL : DE :: GM : GH$, and $Dl : De :: Gm : Gh$, hence, taking the rectangles of the corresponding terms of the proportions, $LD.Dl : ED.De :: MG.Gm : HG.Gh$. But $LD.Dl = MG.Gm$ (2 Cor. 16.), therefore $ED.De = HG.Gh$.

Cor. 1. If a straight line be drawn through D, d, two points in the same branch, or opposite branches, the segments DE, de between these points and the asymptotes are equal. For in the same manner that the rectangles $ED.De$, $HG.Gh$ have been proved to be equal, it may be shewn that the rectangles $Ed.de$, $HG.Gh$ are equal, therefore $ED.De = Ed.de$. Let Ee be bisected in O; then $ED.De = EO^2 - OD^2$, and $Ed.de = EO^2 - Od^2$, therefore $EO^2 - OD^2 = EO^2 - Od^2$; hence $OD = Od$, and $ED = ed$.

Cor. 2. When the points D and d are in the same branch, by supposing them to approach till they coincide at P, the line Ee will thus become a tangent to the curve at P. Therefore any tangent KPk, which is terminated by the asymptotes, is bisected at P, the point of contact.

Cor. 3. And if any straight line KPk, limited by the asymptotes, be bisected at P, a point in the curve, that line is a tangent at P. For it is evident that only one line can be drawn through P, which shall be limited by the asymptotes, and bisected at P.

Cor. 4. If a straight line be drawn through D, any point in the hyperbola, parallel to a tangent KPk, and terminated by the asymptotes at E, and e, the rectangle $ED.De$ is equal to the square of PK, the segment of the tangent between the point of contact and either asymptote. The demonstration is the same as in the Proposition.

Cor. 5. If from any point D in a hyperbola, a straight line be drawn parallel to Pp any diameter, meeting the asymptotes in E and e; the rectangle $ED.De$ is equal to the square of half the diameter. The demonstration is the same as in the Proposition.

Prop. XIX.

If two straight lines be drawn from any point in an hyperbola to the asymptotes, and from any other point in the same branch, or opposite branches, two other lines be drawn parallel to the former, the rectangle contained by the first two lines will be equal to the rectangle contained by the other two lines.

Fig. 47. From D, any point in the hyperbola, draw DH and DK to the asymptotes; and from any other point d, draw dh and dk parallel to DH and DK. The rectangles $HD.DK$, $hd.dk$ are equal. Join D, d, meeting the asymptotes in E and e. From similar triangles $ED : DH :: Ed : dh$, and $eD : DK :: ed : dk$, therefore taking the rectangles of the corresponding terms $ED.De : HD.DK :: Ed.de : hd.dk$; but $ED.De = Ed.de$ (18.), therefore $HD.DK = hd.dk$.

Cor. 1. If the lines $D'K'$, $D'H'$, $d'k'$, $d'h'$, be parallel to the asymptotes, and thus form the parallelograms $D'K'CH'$, $d'k'Ch'$, these are equal to one another (16. and 14. 6. E.) And if $D'C$, $d'C$ be joined, the halves of the parallelograms, or the triangles $D'K'C$, $d'k'C$ are also equal.

Cor. 2. If from D', d', any two points in an hyperbola, straight lines $D'K'$, $d'k'$ be drawn parallel to one asymptote, meeting the other in K' and k', these lines are to each other reciprocally as their distances from the centre, or $D'K' : d'k' :: Ck' : CK'$. This appears from last Cor. and 14. 6. E.

Definitions.

16. If Aa be the transverse axis, and Bb the conjugate axis, of an hyperbola DAD, dad; and if Bb be the transverse axis, and Aa the conjugate axis of another hyperbola EBE, ebe, these hyperbolas are said to be conjugate to each other. Fig. 48.

Cor. The asymptotes of the branches DAD, dad of the one hyperbola, are also the asymptotes of the branches EBE, ebe of the other hyperbola. This is evident from Cor. 2. Def. 14.

17. Any diameter of either of the conjugate hyperbolas, is called *a second diameter of the other hyperbola.*

Cor. Every straight line passing through the centre, within the angle through which the conjugate or second axis passes, is a second diameter of the hyperbola.

18. Any straight line not passing through the centre, but terminated both ways by the opposite branches, and bisected by a second diameter, is called an *Ordinate to that diameter.*

Prop. XX.

Any straight line not passing through the centre, but terminated by the opposite branches, and parallel to a tangent to either of the conjugate hyperbolas, is bisected by the second diameter that passes through the point of contact, or is an ordinate to that diameter.

The straight line Dd, terminated by the opposite branches, and parallel to the tangent KQk, is bisected at E by Qq, the diameter that passes through the point of contact. Fig. 49.

Let Dd meet the asymptotes in G and g, and let the tangent meet them in K and k. The straight lines Gg, Kk, are evidently similarly divided in E and Q, and since $KQ = Qk$ (2. Cor. 18.) therefore $GE = Eg$; now $DG = gd$ (2. Cor. 18.) therefore $DE = Ed$.

Cor. 1. Every ordinate to a second diameter is parallel to a tangent at its vertex. The demonstration is the same as in Cor. 2. Prop. 13.

Cor. 2. All the ordinates to the same second diameter are parallel to each other.

Cor. 3. A straight line that bisects two parallel straight lines, which terminate in the opposite branches, is a second diameter.

Cor. 4. The ordinates to the conjugate or second axis are perpendicular to it, and no other second diameter is perpendicular to its ordinates.

Prop. XXI.

If a transverse diameter of an hyperbola be parallel to the ordinates to a second diameter, the latter shall be parallel to the ordinates to the former. Fig. 50.

Hyperbola.

Fig. 50.

Let Pp, a transverse diameter of an hyperbola, be parallel to DEd, any ordinate to the second diameter Qq, the second diameter Qq shall be parallel to the ordinates to the diameter Pp. Draw the diameter dCG through one extremity of the ordinate dD, and join G and D the other extremity, meeting Pp in H. Because dG is bisected at C, and CH is parallel to Dd, the line DG is bisected at H, therefore DG is an ordinate to the diameter Pp. And because dG and dD are bisected at C and E, the diameter Qq is parallel to DG (2. 6. E.) therefore Qq is parallel to any ordinate to the diameter Pp.

Definitions.

19. Two diameters are said to be *conjugate* to one another, when each is parallel to the ordinates to the other diameter.

Cor. Diameters which are conjugate to one another are parallel to tangents at the vertices of each other.

20. A third proportional to any diameter and its conjugate is called the *Parameter,* also the *Latus rectum* of that diameter.

Prop. XXII.

The tangent at the vertex of any transverse diameter of an hyperbola, which is terminated by the asymptotes, is equal to the diameter that is conjugate to that diameter.

Fig. 51.

Let PCp be any transverse diameter of an hyperbola, HPh a tangent at its vertex, meeting the asymptotes in H and h, and Qq the diameter which is conjugate to Pp; the tangent Hh is equal to the diameter Qq. For through D, any point in the hyperbola, draw a straight line parallel to the tangent and diameter, cutting either of the conjugate hyperbolas in d, and the asymptotes in E and e, and through D and d draw lines parallel to Bb the conjugate axis, meeting the asymptotes in the points K, k, and L, l. The triangles DEK, dEL are similar, as also eDk, edl, therefore $KD : DE :: Ld : dE$, and $kD : De :: ld : de$: therefore, taking the rectangles of the corresponding terms, $KD.Dk :: ED.De :: Ld.dl : Ed.de$. But $KD.Dk = BC^2$ (16.) and $BC^2 = Ld.dl$ (5. Cor. 18.) therefore $ED.De = Ed.de$. Now $ED.De = HP^2$ (4. Cor. 18.) and $Ed.de = QC^2$ (5. Cor. 18.) therefore $HP^2 = QC^2$, and $HP = QC$; and consequently $Hh = Qq$.

Cor. 1. If another tangent be drawn to the curve at p, meeting the asymptotes in H' and h', the straight lines which join the points H, H' also h, h' are tangents to the conjugate hyperbolas at Q and q: for pH' as well as PH is equal and parallel to CQ; therefore the points H, Q, H' are in a straight line parallel to Pp, and $HQ = H'Q$ (33. 1. E.) therefore HQH' is a tangent to the curve at Q (3. Cor. 18.) In like manner it appears that hqh' is a tangent at q.

Cor. 2. If tangents be drawn at the vertices of two conjugate diameters, they will meet in the asymptotes, and form a parallelogram, of which the asymptotes are diagonal.

Prop. XXIII.

If a tangent to an hyperbola meet a second diameter, and from the point of contact an ordinate be drawn to that diameter, half the second diameter will be a mean proportional between the segments of the diameter intercepted between the centre and the ordinate, and between the centre and the tangent.

Hyperbola.

Fig. 52.

Let DL a tangent to the curve at D' meet the second diameter Qq in L, and let DGd' be an ordinate to that diameter, then $CG : CQ :: CQ : CL$. For let Pp be the diameter that is conjugate to Qq, let HPh be a tangent at the vertex, terminated by the asymptotes; through D draw the ordinate DEd to the diameter Pp, meeting the asymptotes in M and m; let K be the intersection of DL and Pp. Because DK is a tangent at D, and DEd an ordinate to Pp, CP is a mean proportionl between CE and CK (14.) and therefore $CE^2 : CP^2 :: CE : CK$. Now the lines CQ, PH, EM being parallel (2. Cor. 13.) from similar triangles $CE^2 : CP^2 :: EM^2 : PH^2$, and CE or $DG : CK :: LG : LC$; therefore $EM^2 : PH^2 :: LG : LC$, and by division, &c. $EM^2 - PH^2 : PH^2 :: CG : LC :: CG^2 : CG.LC$. But since $PH^2 = MD.Dm$ (4 Cor. 18.), $EM^2 - PH^2 = ED^2 = CG^2$, therefore $PH^2 = CG.LC$, wherefore, and since $PH = CQ$ (22.) $CG : CQ :: CQ : CL$.

Prop. XXIV.

If an ordinate be drawn to any transverse diameter of an hyperbola, the rectangle contained by the abscissæ of the diameter will be to the square of the semiordinate as the square of the diameter to the square of its conjugate.

Fig. 52.

Let DEd be an ordinate to the transverse diameter Pp, and let Qq be its conjugate diameter, $PE.Ep : DE^2 :: Pp^2 : Qq^2$. Let DKL, a tangent at, D meet the diameter in K, and its conjugate in L. Draw DG parallel to Pp, meeting Qq in G. Because CP is a mean proportional between CE and CK (14.) $CP^2 : CE^2 :: CK : CE$, and by division, $CP^2 : PE.Ep :: CK : KE$. But, because ED is parallel to CL, $CK : KE :: CL : DE$ or CG; and because CQ is a mean proportional between CG and CL (23.) $CL : CG :: CQ^2 : CG^2$, or DE^2, therefore $CP^2 : PE.Ep :: CQ^2 : DE^2$, and by inversion, and alternation, $PE.Ep : DE^2 :: CP^2 : CQ^2 :: Pp^2 : Qq^2$.

Cor. 1. If an ordinate be drawn to any second diameter of an hyperbola, the sum of the squares of half the second diameter, and its segment intercepted by the ordinate from the centre, is to the square of the semiordinate as the square of the second diameter to the square of its conjugate.

Let DG be a semiordinate to the second diameter Qq. It has been shewn that DE^2 or $CG^2 : CQ^2 :: PE.Ep : CP^2$, therefore by composition $CQ^2 + CG^2 : CQ^2 :: CE^2$ or $DG^2 : CP^2$; and by alternation, $CQ^2 + CG^2 : DG^2 :: CQ^2 : CP^2 :: Qq^2 : Pp^2$.

Cor. 2. The squares of semiordinates, and of ordinates to any transverse diameter, are to one another as the rectangles contained by the corresponding abscissæ; and the squares of semiordinates, and of ordinates to any second diameter, are to one another as the sums of the squares of half that diameter, and the segments intercepted by the ordinates from the centre.

Cor. 3. The ordinates to any transverse diameter, which intercept equal segments of that diameter from the centre, are equal to one another, and, conversely, equal ordinates intercept equal segments of the diameter from the centre.

Prop. XXV.

The transverse axis of an hyperbola is the least of all its transverse diameters, and the conjugate axis is the least of all its second diameters.

Hyperbola.

Fig. 53.

Let Rr be the transverse axis, Pp any other transverse diameter, draw PE perpendicular to Rr; then CE being greater than CR, and CP greater than CE, much more is CP greater than CR; therefore Pp is greater than Rr. In like manner it is shewn, that if Ss be the conjugate axis, and Qq any other second diameter, Qq is greater than Ss.

Prop. XXVI.

If an ordinate be drawn to any transverse diameter of an hyperbola, the rectangle contained by the abscissæ of the diameter is to the square of the semiordinate as the diameter to its parameter.

Fig. 54.

Let DE be a semiordinate to the transverse diameter Pp; let PG be the parameter of the diameter, and Qq the conjugate diameter. By the definition of the parameter (Def. 20.) $Pp : Qq :: Qq : PG$, therefore $Pp : PG :: Pp^2 : Qq^2$, (2 Cor. 20. 6. E.) But $Pp^2 : Qq^2 :: PE.Ep : DE^2$, (24.) therefore $PE.Ep : DE^2 :: Pp : PG$.

Cor. Let the parameter PG be perpendicular to the diameter Pp; join pG, and from E draw EM parallel to PG meeting pG in M. The square of DE the semiordinate is equal to the rectangle contained by PE and EM. For $PE.Ep : DE^2 :: Pp : PG$, and $Pp : PG :: Ep : EM :: PE.Ep :: PE.EM$; therefore $DE^2 = PE.EM$.

Scholium.

If the rectangles $PGLp$, HGKM be completed, it will appear that the square of ED is equal to the rectangle MP, which rectangle is greater than the rectangle KP, contained by the abscissa PE and the parameter GP, by a rectangle KH similar, and similarly situated to LP, the rectangle contained by the parameter and diameter. It was on account of the excess of the square of the ordinate above the rectangle contained by the abscissa and parameter that Apollonius gave the curve to which the property belongs the name *Hyperbola*.

Prop. XXVII.

If from the vertices of two conjugate diameters of an hyperbola there be drawn ordinates to any third transverse diameter, the square of the segment of that diameter, intercepted between the ordinate from the vertex of the second diameter, and the centre, is equal to the rectangle contained by the segments between the other ordinate and the vertices of the third transverse diameter. And the square of the segment intercepted between the ordinate from the vertex of the transverse diameter, and the centre, is equal to the square of the segment between the other ordinate and the centre, together with the square of half the third transverse diameter.

Fig. 53.

Let Pp, Qq be two conjugate diameters, of which Pp is a transverse, and Qq a second diameter; let PE, QG be semiordinates to any third transverse diameter Rr, then, $CG^2 = RE.Er$ and $CE^2 = CG^2 + CR^2$. Draw the tangents PH, QK, meeting Rr in H and K. The rectangles HC.CE and KC.CG are equal, for each is equal to CR^2 (14. and 23.) therefore $HC : CK :: CG : CE$. But the triangles HPC, CQK are evidently similar (Cor. to Def. 19.) and since PE, QG are parallel, their bases CH, KC are similarly divided at E and G, therefore $HC : CK :: HE : CG$, wherefore $CG : CE :: HE : CG$, consequently $CG^2 = CE.EH =$ (by 1. Cor. 14.) $RE.Er$. Again, from the similar triangles HPC, CQK, $HC : CK :: CE : KG$. Now it was shewn that $HC : CK :: CG : CE$, therefore $CG : CE :: CE : KG$. consequently $CE^2 = CG.GK =$ (3.2.E.) $CG^2 + GC.CK$, But $GC.CK = CR^2$ (23.) therefore $CE^2 = CG^2 + CR^2$.

Hyperbola.

Cor. 1. Let Ss be the diameter that is conjugate to Rr, then Rr is to Ss as CG to PE, or as CE to QG. For $Rr^2 : Ss^2 :: RE.Er$, or $CG^2 : PE^2$, therefore $Rr : Ss :: CG : PE$. In like manner $Rr : Ss :: CE$ QG.

Cor. 2. The difference between the squares of CE, CG, the segments of the transverse diameter to which the semiordinates PE, QG are drawn, is equal to the square of CR, the semidiameter. For it has been shewn that $CE^2 = CG^2 + CR^2$; therefore $CE^2 - CG^2 = CR^2$.

Cor. 3. The difference of the squares of any two conjugate diameters is equal to the difference of the squares of the axes. Let Rr, Ss be the axes, and Pp, Qq any two conjugate diameters; draw PE, QG perpendicular to Rr, and PL, QM perpendicular to Ss. Then $CE^2 - CG^2 = CR^2$, and $CM^2 - CL^2$, or $GQ^2 - PE^2 = CS^2$, therefore $CE^2 + PE^2 - (CG^2 + GQ^2) = CR^2 - CS^2$, that is (47. 1. E.) $CP^2 - CQ^2 = CR^2 - CS^2$, therefore $Pp^2 - Qq^2 = Rr^2 - Ss^2$.

Prop. XXVIII.

If four straight lines touching conjugate hyperbolas at the vertices of any two conjugate diameters, the parallelogram formed by them is equal to the rectangle contained by the transverse and conjugate axis.

Let Pp, Qq be any two conjugate diameters, a parallelogram DEGH formed by tangents to the conjugate hyperbolas at their vertices is equal to the rectangle contained by Aa, Bb, the two axes. Fig. 55.

Let Aa, one of the axes, meet the tangent PE in K; join QK, and draw PL, QM perpendicular to Aa. Because $CK : CA : CA : CL$ (14.) and $CA : CB :: CL : QM$ (1. Cor. 26.) ex æq. $CK : CB :: CA : QM$; therefore $CK.QM = CB.CA$. But $CK.QM =$ twice the trian. CKQ=paral. CPEQ; therefore the paral. CPEQ $= CB.CA$; and, taking the quadruples, the parallelogram DEGH is equal to the rectangle contained by Aa and Bb.

Prop. XXIX.

If two tangents at the vertices of any transverse diameter of an hyperbola meet a third tangent, the rectangle contained by their segments between the points of contact, and the points of intersection, is equal to the square of the semidiameter to which they are parallel. And the rectangle contained by the segments of the third tangent between its point of contact and the parallel tangents, is equal to the square of the semidiameter to which it is parallel.

Let PH, ph, tangents at the vertices of a transverse diameter Pp, meet DHh, a tangent to the curve, at any point D, in H and h; let CQ be the semidiameter to which the tangents PH, ph are parallel, and CR that to which Hh is parallel; then $PH.ph = CQ^2$, and $DH.Dh = CR^2$; let Hh meet the semidiameters CP, CQ in L and K. Draw DE, RM parallel to CQ, and DG parallel to CP. Because $LP.Lp = LE.LC$ (2. Cor. 14.), $LP : LE :: LC : Lp$; hence, and because of the parallels PH, ED, CK, ph, $PH : ED :: CK : ph$, wherefore $PH.ph = ED.CK$. But $ED.CK = CG.CK = CQ^2$ (23.), therefore $PH.ph = CQ^2$. Again, the triangles LED, CMR are evidently similar, and Fig. 56.

Hyperbola.

LE, LD are similarly divided at P and H, also at p and h, therefore PE : HD : : (LE : LD) CM : CR, also pE : hD : : (LE : LD : :) CM : CR, hence taking the rectangles of the corresponding terms, PE.pE : HD.hD : : $CM^2 : CR^2$. But if C, D be joined, the points D and R are evidently the vertices of two conjugate diameters (Cor. to Def. 19.), and therefore PE.pE=CM^2 (27.), therefore HD.hD=CR^2.

Cor. The rectangle contained by LD and DK, the segments of a tangent intercepted between D, the point of contact, and Pp, Qq, any two conjugate diameters, is equal to the square of CR, the semidiameter to which the tangent is parallel.

Let the parallel tangents PH, $p\,h$, meet LK in H and h, and draw DE a semiordinate to Pp. Because of the parallels ED, PH, CK, ph, LE : LD : : EP : DH, and EC : DK : : Ep : Dh, therefore LE.EC : LD.DK : : EP.Ep : DH.Dh. But LE.EC=EP.Ep (1. Cor. 14.), therefore LD.DK=DH.Dh= (by this Prop.) CR^2.

Prop. XXX.

If two straight lines be drawn from the foci of an hyperbola perpendicular to a tangent, straight lines drawn from the centre, to the points in which they meet the tangents, will each be equal to half the transverse axis.

Fig. 57. Let PdD be a tangent to the curve at P, and FD, fd perpendiculars to the tangent from the foci, the straight lines joining the points C, D and C, d are each equal to AC, half the transverse axis. Join FP, fP, and produce FD, Pf till they intersect in E. The triangles FDP, EDP have the angles at D right angles, and the angles FPD, EPD equal (8.), and the side DP common to both; they are therefore equal, and consequently have ED=DF, and EP=PF, wherefore Ef=FP—Pf=Aa. Now, the straight lines FE, Ff being bisected at D and C, the line DC is parallel to Ef, (2. 6. E.) and thus the triangles FfE, FCD are similar, therefore Ff:fE, or Aa : : FC : CD: but FC is half Ff, therefore CD is half of Aa.

Cor. If a straight line Qq be drawn through the centre parallel to the tangent Dd, it will cut off from PF, Pf the segments PG, Pg, each equal to AC, half the transverse axis. For CdPG, CDPg are parallelograms, therefore PG=dC=AC, and Pg=DC=AC.

Prop. XXXI.

The rectangle contained by perpendiculars drawn from the foci of an hyperbola to a tangent, is equal to the square of half the conjugate axis.

Fig. 57. Let PdD be a tangent, and FD, fd perpendiculars from the foci, the rectangle contained by FD and fd is equal to the square of BC, half the conjugate axis.

It is evident from the last Proposition, that the points D, d are in the circumference of a circle, having the same centre as the hyperbola, and radius CA half the transverse axis. Now, FDd being a right angle, if dC be joined, and produced, it will meet DF in H, a point in the circumference (31. 3. E.); and since FC=fC, and CH=Cd, and the angles FCH, fCd are equal, FH is equal to fd, therefore DF.df=DF.FH=AF.aF (Cor. 36. 3. E.)=CB^2 (3.)

Cor. If PF, Pf be drawn from the point of contact to the foci, the square of FD is a fourth proportional to fP, FP, and CB^2. For the angles fPd, FPD are equal (8.), and FDP, fdP are right angles, therefore the triangles FDP, fdP are similar, and fP : FP : : fd : FD : : fd.FD or $BC^2 : FD^2$.

Prop. XXXII.

If from C, the centre of an hyperbola, a straight line CL be drawn perpendicular to a tangent LD, and from D, the point of contact, a perpendicular be drawn to the tangent, meeting the transverse axis in H, and the conjugate axis in h, the rectangle contained by CL and DH is equal to the square of CB, the semiconjugate axis; and the rectangle contained by CL and Dh is equal to the square of CA, the semitransverse axis. Fig. 58.

Let the axes meet the tangent in M and m, and from D draw the semiordinates DE, De, which will be perpendicular to the axes. The triangles DEH, CLm are evidently equiangular, therefore DH : DE : : Cm : CL, hence CL.DH=DE.Cm, but DE.Cm or Ce.Cm=BC^2 (15.), therefore CL.DH=BC^2. In the same way it is shewn that CL.Dh=AC^2.

Cor. 1. If a perpendicular be drawn to a tangent at the point of contact, the segments intercepted between the point of contact and the axes are to each other reciprocally as the squares of the axes by which they are terminated. For $AC^2 : BC^2$: CL.Dh : CL.DH : : Dh : DH.

Cor. 2. If DF be drawn to either focus, and HK be drawn perpendicular to DF, the straight line DK shall be equal to half the parameter of the transverse axis. Draw CG parallel to the tangent at D, meeting DH in N, and DF in G. The triangles GDN, HDK are similar, therefore GD : DN : : HD : DK; and hence GD.DK=HD.DN. But GD=AC (Cor. 30.) and ND=CL, therefore AC.DK=HD.CL= (by the Prop.) CB^2, wherefore AC : BC : : BC : DK, hence DK is half the parameter of Aa, (Def. 20.)

Prop. XXXIII.

If through P and Q, the vertices of two semidiameters of an hyperbola, there be drawn straight lines PD, QE parallel to one of the asymptotes CM, meeting the other asymptote in D and E, the hyperbolic sector PCQ is equal to the hyperbolic trapezium PDEQ. Fig. 59.

Let CQ meet PD in T, the triangles CDP, CEQ are equal (1. Cor. 19.); therefore, taking the triangle CDT from both, the triangle CTP is equal to the quadrilateral DEQT: to these add the figure PTQ, and the hyperbolic sector PCQ is equal to the hyperbolic trapezium PDEQ.

Prop. XXXIV.

If from the centre of an hyperbola the segments CD, CE, CH be taken in continued proportion in one of the asymptotes, and the straight lines DP, EQ, HR be drawn parallel to the other asymptote, meeting the hyperbola in P, Q, R; the hyperbolic areas PDEQ, QEHR are equal. Fig. 59.

Through Q draw a tangent to the curve, meeting the asymptotes in K and L; join PR, meeting the asymptotes in M and N; draw the semidiameters CP, CQ, CR; let CQ meet PR in G. Because QE is parallel to CM, and KQ is equal to QL (2. Cor. 18.), CE is equal to EL; and because MC, PD, RH are parallel, and MP is equal to RN (1. Cor. 18.), CD is equal to HN. Now, by hypothesis, CD : CE : : CE : CH, therefore NH : LE : : CE : CH; but CE : CH : : HR : EQ

Hyperbola.

(2. Cor. 19.), therefore NH : LE : : HR : EQ, and by alternation, NH : HR : : LE : EQ. Now the angles at H and E are equal, therefore the triangles NHR, LEQ are equiangular, and NR is parallel to LQ; consequently, RP is an ordinate to the diameter CQ (13.), and is bisected by it at G; and as CQ bisects all lines which are parallel to KL, and are terminated by the hyperbola, it will bisect the area PQR. Let the equal areas PQG, RQG be taken from the equal triangles PCG, RCG, and there will remain the hyperbolic sectors PCQ, RCQ equal to each other. Therefore (33.) the areas DPQE, EQRH are also equal.

Cor. Hence, if CD, CE, CH, &c. any number of segments of the asymptote be taken in continued proportion, the areas DPQE, DPQRH, &c. reckoned from the first line DP, will be in arithmetical progression.

Prop. XXXV. *Problem.*

An hyperbola being given by position, to find its axes.

Fig. 60.

Let H*A*h be the given hyperbola. Draw two parallel straight lines Hh, Kk, terminating in either of the opposite branches, and bisect them at L and M; join LM, and produce it to meet the hyperbola in P; then LP will be a transverse diameter (4. Cor. 13.) Let p be the point in which it meets the opposite branch, bisect Pp in C; the point C is the centre (9.) Take D, any point in the hyperbola, and on C as a centre, with the distance CD, describe a circle; if this circle be wholly without the opposite branches of the hyperbola, then CD must be half the transverse axis (25.); but if not, let the circle meet the hyperbola again in d, join Dd, and bisect it in E, join CE meeting the opposite branches in A and a; then Aa will be the transverse axis (5. Cor. 13.), for it is perpendicular to Dd (3. 3. E.), which is an ordinate to Aa. The other axis will be found, by drawing Bb a straight line through the centre perpendicular to Aa, and taking CB so, that CB^2 may be a fourth proportional to the rectangle AE.Ea, and the squares of DE and CA, thus CB is half the conjugate axis, (24.)

SECTION IV.

Of the Parabola.

Definitions.

Fig. 61.

1. Let PQ be a straight line given by position, and F a given point without it, and let a point D move in their plane, in such a manner that DF, its distance from the given point, is equal to DE, its distance from the given line; the point D will describe a curve line, called a *Parabola.*

2. The straight line PQ is called the *Directrix.*

3. The given point F is called the *Focus.*

Corollaries to Def. 1, 2, and 3. If a straight line FP be drawn through the focus perpendicular to the directrix at P, the parabola passes through A, the middle of FP, and it cannot meet the perpendicular FP in any other point.

2. If MFm be drawn perpendicular to FP, and FM and Fm be each taken equal to FP, the parabola will pass through M and m, and through no other points in the line Mm.

Parabola.

Def. 4. The straight line AF produced indefinitely, is called the *Axis.*

5. The point A, in which the axis meets the curve, is called the *Vertex.*

Scholium.

Fig. 61.

From the definition of the curve, we have the following method of describing it mechanically. Place the edge of a fixed ruler along PQ the directrix, and to this edge apply another moveable ruler, LEG, of any length which is so constructed that one of its sides EG is always perpendicular to EQ. Fasten one end of a string equal in length to GE at G the end of this ruler, and the other at F the focus; and pull the string tight by passing it round a pin D, which slides along GE. If the moveable ruler be now made to slide along the fixed ruler, and the pin D along the line EG, so as to keep the string always extended into the two straight lines GD, DF, it is evident that the pin will trace the parabola.

Prop. I.

Fig. 62.

If a circle be described on F the focus as a centre, with a radius equal to FP its distance from the directrix; and from any point D in the parabola a straight line be drawn to the focus and produced to meet the circle in I, and IN be drawn perpendicular to the axis; the rectangle FD.PN is equal to the constant space PF^2.

Draw DE perpendicular to the directrix, and join EF, PI. The triangles EDF, PFI are similar (6. 6. E.) for ED=DF, (Def. 1.) and PF=FI, and the angles EDF, PFI are equal (29. 1. E.) therefore FE is parallel to PI (28. 1.) The triangles FPE, PNI are also equiangular; for the angles at P and N are right angles, and the angles EFP, NPI are equal (29. 1. E.) Hence DF : FE : : IF : IP; and FE : FP : : IP : PN (4. 6. E.) therefore, ex æq. DF : FP : : IF : PN (22. 5. E.) and $DF.PN=FP.FI=FP^2$ (16. 6. E.)

Cor. Hence the point in which a line drawn from the focus meets the curve may be found, viz. by taking FD a third proportional to PN and FP.

Scholium.

From this Proposition we learn what is the figure of the curve, by considering the change that takes place in the magnitude of the line FD, corresponding to a change in its position. When FD has the position FA, the points I and N are at L, and as in this case PN, one side of the constant rectangle FD.PN is the greatest possible; the other side FD must be the least. Suppose now FD to depart from the position FA, and to revolve about F; then, as the angle PFD, or IFL increases, the point N will approach to P, and as PN one side of the rectangle FD.PN now decreases until it vanishes, FD its other side must increase; and go on increasing until it has attained a magnitude greater than any that can be assigned. In general, we may conclude,

1. That the parabola is a continuous curve, which passes through A the middle of FP, and extends to an indefinite distance from the focus on both sides of the axis.

2. That every line which can be drawn from the focus will, if produced, terminate in the curve, with the exception of FX the prolongation of FA; and that the least will be FA, and of the others, those nearer the least will be less than those more remote.

Parabola.

3. That lines drawn from the focus at equal angles with the axis on opposite sides of it, and terminating in the curve, are equal to one another.

Definition.

6. A straight line which meets a parabola, and being produced does not cut it, is said to *touch* the curve, and is called a *Tangent.*

PROP. II. *Problem.*

Having given the focus, and directrix, and consequently the axis, to find the points in which a straight line perpendicular to the axis meets the curve.

Fig. 63. Let RS, the line given by position, meet the axis in G, on the focus F as a centre, with a radius equal to PG, the distance of the line from the directrix, describe a circle to meet the line in D and d, which will be points in the parabola.

For draw DE, de perpendicular to the directrix, then DE=PG=DF, and de=PG=dF; therefore D and d are points in the parabola. (Def. 1.)

The construction of the problem requires that FG should not exceed FD, that is PG; but this condition will manifestly be fulfilled if G be any where in AX the prolongation of PA, and it would not be fulfilled if G were between P and A: Therefore the line given by position must not be nearer to the directrix than to the focus.

COR. 1. Every straight line perpendicular to the axis that does not pass through the vertex meets the curve in two points, and no more; if it pass through the vertex, it will meet the curve in one point only, and if it be nearer to the directrix than to the focus, it will not meet the curve at all.

COR. 2. Every chord perpendicular to the axis is bisected by the axis.

COR. 3. A perpendicular to the axis at the vertex is a tangent.

PROP. III. *Problem.*

Having the focus and directrix, and consequently the axis, to find the point in which a line parallel to the axis meets the parabola.

Fig. 64. Let ER, the line given by position, meet the directrix in E. Draw FE to the focus, and bisect EF at O, by a perpendicular OT; and because PER is a right angle, the angle OER is not a right angle, and therefore the lines ER, OT will meet at a point D, which will be a point in the parabola. For the triangles FOD, EOD are manifestly in all respects equal (4. 1. E.), therefore DF=DE; and hence D is a point in the parabola (Def. 1.)

COR. Every straight line parallel to the axis meets the parabola in one point and no more. For besides D, no other point can be found in ER that is equally distant from E and F.

PROP. IV.

Fig. 65. If from any point Q in the directrix a straight line be drawn to meet the parabola in D, and LF l a parallel to the directrix through the focus in H; and if another straight line be drawn to D from the focus, a perpendicular QK, drawn to this last line from Q, shall be equal to FH, the segment cut off by the former from the line FL.

Draw DE perpendicular to the directrix, and produce DF to meet it in I. The triangles DFH, DIQ are manifestly equiangular (29. 1. E.) as also the triangles IED, IKQ (32. 1. E.) therefore, DF : FH (:: DI : IQ) :: DE : QK; but DF=DE, (Def. 1.) therefore FH=QK.

Parabola.

COR. 1. If the lines FD, QH have such a position that FH is equal to QK the perpendicular drawn from Q to FD; then if FD and QH are not parallel, they will meet at D, a point in the parabola.

COR. 2. If QF be drawn to the focus, and in LF l, which is parallel to the directrix, there be taken FL, and F l each equal to FQ, then, any straight line drawn from Q to meet the parabola will either pass through the points L, l, or between these points. For QK cannot exceed QF, therefore FH cannot exceed FL.

COR. 3. Any straight line drawn from Q, to pass beyond the limits L l will be entirely without the parabola.

PROP. V. *Problem.*

The focus and directrix being given, to find the points in which a straight line not perpendicular to the axis meets the curve.

CASE 1. Let the line given by position be XY, which passes through F the focus. Draw FQ perpendicular to XY, meeting the directrix in Q, and in a line passing through F, parallel to the directrix, take FL and F l each equal to FQ; and join QL, Q l, then as the angles FQL, FQ l cannot be right angles (5. and 17. 1. E.) the lines QL, Q l must meet XY in two points D, d, which will be in the parabola. (Cor. 1.) Fig. 66.

CASE 2. Next, let the line given by position meet the directrix in Q (Fig. 67.) and the parallel LF l in H, so that FL and F l being taken each equal to FQ, the point H may fall between L and l. On Q as a centre, with a radius equal to FH, (which is less than FL or FQ,) describe a circle; draw FK, F k tangents to that circle at K and k; and if neither of these is parallel to QH, they will meet it in D, d, which will be two points in the parabola, as is evident from Cor. 1. Prop. 4. by joining QK, Q k. Fig. 67.

If one of the lines, as F k, were parallel to QD, so that there was only one intersection, then as FH=Q k, the figure kQHF would, in that case, be a rectangle, and so QH would be perpendicular to FL, or parallel to the axis, a conclusion which agrees with what has been already shewn in Prop. 3.

CASE 3. Lastly, let the line Q l, given by position, pass through l, either of the two points L, l, determined as above. Draw FD′ perpendicular to FQ, and because FQ l is not a right angle (7. 6. and 17. 1. E.) the lines Q l, FD′ must meet, and D′, their intersection, is a point in the parabola (1. Cor. 4.)

COR. 1. The points L, l being supposed determined as in the proposition, every straight line drawn from Q to pass between L and l, either meets the curve in one point only, or in two points and no more; for the number of intersections cannot exceed the number of tangents to the circle, as has been explained in Sect. II. Prop. 7.

COR. 2. A straight line drawn from Q, through L, or l, meets the curve in one point only, and is a tangent. The reason is the same as has been given in the like case of Prop. 7. Sect. II.

COR. 3. Every straight line which meets a parabola cuts it in one point only, or in two points, and no more, or it touches it, and these are all the varieties that can happen.

COR. 4. If two lines FD, FQ, which contain a right angle at the focus, meet the curve in D, and the di-

Parabola. rectrix in Q; a line joining Q and D shall be a tangent at D; and only one tangent can be drawn at that point. It is evident from Case 3, and Corollary 3, that DQ is a tangent; and to prove that no other can be drawn at D; (Fig. 68.) draw DHQ′ any other line, meeting the directrix, and its parallel in Q′ and H′; draw QK perpendicular to FD, and take FL=FQ′; then, because FH=Q′K (4.) and FL=Q′F (by construction) therefore FH is less than FL; hence the line Q′D cuts the parabola, as appears from the first corollary.

Fig. 68.

Cor. 5. Tangents drawn at the extremities of a chord passing through the focus, meet in the directrix, and form a right angle; and a perpendicular to the chord at the focus meets the directrix, at their intersection. See Fig. 66.

Prop. VI.

A tangent to a parabola makes equal angles with a straight line drawn from the point of contact to the focus, and another perpendicular to the directrix.

Fig. 69. If the tangent be at the extremity of the axis, the truth of the proposition is evident from Cor. 3. Prop. 2. If it have any other position, as DQ, let it meet the directrix in Q, and draw DF to the focus, and DE perpendicular to the directrix; And because FD=DE and QD is common to the triangles QFD, QED, and the angles at F and E are right angles (by Hyp. and 4. Cor. 5.) the triangles are in all respects equal (47. and 8. 1. E.) hence the angles QDE, QDF are equal.

Cor. 1. The straight line FE, which joins the points F and E, is perpendicular to the tangent, and is bisected by it. For the triangles DEI, DFI, are evidently equal in all respects (4. 1. E.)

Cor. 2. Every tangent, except that at the vertex, meets the directrix at an oblique angle.

Definition.

7. A straight line parallel to the axis, which terminates at one extremity in the parabola, and lies entirely within it, is called a *diameter*, and the point in which it meets the curve is called its *vertex*.

Prop. VII.

A straight line drawn from the focus of a parabola to the intersection of two tangents, makes equal angles with straight lines drawn from the focus to the points of contact.

Fig. 70. Let tangents to a parabola at D and *d* intersect each other at H; draw DF, *d* F, HF, to the focus; the lines DF, *d* F make equal angles with HF.

Draw DE, *de* perpendicular to the directrix, and join HE, H*e*. The triangles HDE, HDF are in all respects equal, (4. 1. E.) for they have DE = DF, and DH common to both; and the angles at D equal; therefore HE=HF, and the angle HED is equal to HFD. In the same way it may be proved, that the triangles H *d e*, H *d*F are equal, and consequently that HF=H*e*, and the angle HF *d* to the angle H *e d*; but HE being equal to H *e*, for each has been proved equal to HF, the angles HE *e*, H *e* E are equal, (5. 1. E.) and adding the right angles *e*ED, E *ed*; the angles HED, H *e d* are equal; but these have been proved equal to HFD, HF *d*, therefore the line HF makes equal angles with FD, F *d*.

Cor. 1. Perpendiculars drawn from the intersection of two tangents to lines drawn from the focus through the points of contact, are equal. For HI, H *i*, being drawn perpendicular to DF, *d*F; the triangles HFI, HF *i* are manifestly equal (26. 1. E) and therefore HI=H *i*. Parabola.

Cor. 2. Perpendiculars from the intersection of two tangents to diameters passing through the points of contact are equal.

Draw GH *g* through H perpendicular to DG, *dg*; and because the triangles HDG, HDI have HD common to both, the angles at D equal, and the angles at G and I right angles, they are in all respects equal, (26. 1. E.) and HG=HI; in like manner it appears that H *g*=H *i*; but HI = H *i*, therefore HG=H*g*.

Cor. 3. If a straight line HF be drawn to the focus, from the intersection of two tangents HD, H *d*, and another HK be drawn perpendicular to the directrix; these will make equal angles with the tangents.

The triangles EHK, *e*HK are equiangular (32. 1. E.) for the angles at K are right angles, and the angles at E and *e* equal (5. 1. E.) therefore the angles EHK, *e* HK are equal; but EHK=EHD+DHK=DHF+DHK = FHK+2 DHF; and *e* HK=*e*H *d*+*d* HK=*d* HF+*d* HK=FHK+2*d*HK, therefore FHK+2DHF =FHK +2 *d* HK, and 2 DHF =2 *d* HK, or DHF= *d* HK.

Prop. VIII.

If two tangents be at the extremities of a chord, and a third tangent be parallel to the chord, the part of this tangent intercepted between the other two is bisected at the point of contact.

Let HD, H *d* be tangents at the extremities of the chord D*d*, and K *p k* a tangent parallel to the chord, meeting the others in K and *k*; the line K *k* is bisected at P, the point of contact. From the intersection of each two tangents, draw perpendiculars upon the diameters passing through their points of contact, that is, draw HI, H *i* perpendicular to the diameters DL, *d l*, and KM, K *m* perpendicular to the diameters DL, PE, and *k*N, *k n* perpendicular to the diameters *d l*, PE. Fig. 71.

The triangles DHI, DKM are manifestly equiangular, as also the triangles *d* H *i*, *d k* N; therefore HD : DK :: HI : KM, and H *d* : *d k* :: H *i* : *k* N, (4. 6. E.) but because K*k* is parallel to D*d*, HD : DK :: H*d* : *dk* (2. 6. E.) therefore HI : KM :: H *i* : *k* N, now HI=H *i* (2. Cor. 7.) therefore KM=*k* N; but KM=K *m*, and KN=*k n* (2 Cor. 7.) therefore K *m*=*k n*, and since we have manifestly K *m* : *k n* : : KP : *k* P (4. 6. E.) therefore KP=*k* P.

Definitions.

8. Any chord that is bisected by a diameter is called an *ordinate* to that diameter.

9. The segment of a diameter between its vertex and an ordinate is called an *abscissa*.

Prop. IX.

Any chord parallel to a tangent, is bisected by the diameter which passes through the point of contact, or is an ordinate to that diameter.

The chord D*d*, which is parallel to the tangent KP*k*, is bisected at E by PE, the diameter that passes through P, the point of contact. For, let HD, H*d*, be tangents, and DN, D*n* diameters at the extremities of the chord, and let the tangent at P meet the former in K, *k*, and the latter in L, *l*; also through H draw OH*o* parallel- Fig. 72.

Parabola. lel to Dd; and IHi perpendicular to the diameters DN, dn. The triangles DKL, DHO, are manifestly similar, as also the triangles dkl, dHo, and the triangles IHO, iHo; therefore, DK : DH :: KL : HO, and dk : dH :: kl : Ho; (4. 6. E.) but because Kk is parallel to Dd, DK : DH :: dk : dH (2. 6. E.), therefore, KL : HO :: kl : Ho; but HO : HI :: Ho : Hi; therefore ex æquali KL : HI :: kl : Hi (22. 5. E.), but HI = Hi (2. Cor. 7.), therefore KL = kl, now KP = kP (8.), therefore PL = Pl, and (34. 1. E.) ED = Ed.

Cor. 1. Straight lines which touch a parabola at the extremities of an ordinate to a diameter, intersect each other in that diameter; for Kk and Dd being bisected at P and E, the points H, P, E, lie in a straight line, (Lemma to Prop. 13. Sect. II.)

Cor. 2. Every ordinate to a diameter is parallel to a tangent at its vertex; for if not, let a tangent be drawn parallel to the ordinate; then the diameter passing through the point of contact would bisect the ordinate, and thus the same line would be bisected in two different points, which is absurd.

Cor. 3. All the ordinates to the same diameter are parallel to each other.

Cor. 4. A straight line that bisects two parallel chords, and terminates in the curve, is a diameter.

Cor. 5. The ordinates to the axis are perpendicular to it, and no other diameter is perpendicular to its ordinates. This is evident from 3. Cor. Prop. 2. and 2. Cor. Prop.

Prop. X.

If a tangent at any point in a parabola meet a diameter, and from the point of contact an ordinate be drawn to that diameter, the segment of the diameter between the vertex and the tangent is equal to the segment between the vertex and the ordinate.

Fig 73. Let DH, a tangent to the curve at D, meet the diameter EP in H, and let DEd be an ordinate to that diameter: PH is equal to PE. For draw PK, a tangent at P, meeting the tangent DH in K; and draw iKI perpendicular to the diameter PE at i, meeting a diameter drawn through D at I: And because Hi is parallel to DI, and PK to DE, we have IK : iK :: DK : HK :: EP : HP (2. 6. E.), but IK = iK (2. Cor. 7.), therefore EP = HP.

Definition.

10. A straight line quadruple the distance between the vertex of a diameter and the directrix, is called the *Parameter*, also the *Latus Rectum* of that diameter.

Prop. XI.

If an ordinate to any diameter pass through the focus, the abscissa is equal to one fourth of the parameter of that diameter, and the ordinate is equal to the whole parameter.

Fig. 74. Let DEd, a straight line passing through the focus, be an ordinate to the diameter PE; the abscissa PE is equal to one fourth of the parameter, and the ordinate Dd is equal to the whole parameter of the diameter PE. Let DK, PI, be tangents at D and P; let DK meet the diameter in K; draw PF to the focus, and DL parallel to EP. The angles KPI, IPF, being equal (6.), and PI parallel to EF (2. Cor. 9.), the angles PEF, PFE, are also equal (29. 1. E.), and PE = PF = $\frac{1}{4}$ the parameter (Def. 1. and 10.) Again, the angle KDE is equal to LDK (6.), and therefore equal to DKE; consequently ED is equal to EK, or to twice EP (10.); therefore Dd is equal to 4 EP, or to 4 PF, that is, to the parameter of the diameter, (Def. 10.)

Prop. XII.

If any two diameters of a parabola be produced to meet a tangent to the curve, the segments of the diameters between their vertices and the tangent are to one another as the squares of the segments of the tangent intercepted between each diameter and the point of contact.

Let QH, RK, any two diameters, be produced to meet PI, a tangent to the curve at P, in the points G, I; then HG : KI :: PG^2 : PI^2. For let PN, a semiordinate to the diameter HQ, meet KR in O; and let PR, a semiordinate to the diameter KO, meet HN in Q; from H draw parallels to NO and QR, meeting KR in L and M; thus HL is a tangent to the curve, and HM a semiordinate to KR. Now KI = KR, and KL = KM, (10.) Therefore, by subtraction, LI = MR = HQ, but LO = HN = HG (10.); therefore, by addition, IO = GQ. The triangles PGN, PIO, are similar, as also PGQ, PIR; therefore GN : IO, or 2 GH : IO :: PG : PI, and GQ : IR, or IO : 2 IK :: PG : PI; hence, taking the rectangles of the corresponding terms, 2 GH . IO : 2 IO . IK :: PG^2 : PI^2; therefore GH : IK :: PG^2 : PI^2. Fig. 75.

Cor. The squares of semiordinates, and of ordinates to any diameter, are to one another as their corresponding abscissæ. Let HEh, KNk, be ordinates to the diameter PN; draw PG a tangent to the curve at the vertex of the diameter, and complete the parallelograms PEHG, PNKI; then PG, PI, are equal to EH, NK; and GH, IK, to PE, PN, respectively; therefore HE^2 : KN^2 :: PE : PN. Fig. 76.

Prop. XIII.

If an ordinate be drawn to any diameter of a parabola, the rectangle under the abscissa and the parameter of the diameter, is equal to the square of the semiordinate.

Let HBh be an ordinate to the diameter PB, the rectangle contained by PB and the parameter of the diameter is equal to the square of HB, the semiordinate. Let DEd be that ordinate to the diameter which passes through the focus. The semiordinates DE, Ed, are each half of the parameter; and the abscissa EP is one-fourth of the parameter (11.), therefore Dd : DE :: DE : PE, and Dd.PE = DE^2, but Dd.PE : Dd.PB :: (PE : PB ::) DE^2 : HB^2 (Cor. 12.), therefore Dd . PB = HB^2. Fig. 74.

Scholium.

It was on account of the equality of the square of the semiordinate to a rectangle contained by the parameter of the diameter and the abscissa, that Apollonius called the curve to which the property belongs a *Parabola.*

Prop. XIV.

A straight line drawn from the focus of a parabola, perpendicular to a tangent, is a mean proportional between the straight line drawn from the focus to the point of contact, and one-fourth of the parameter of the axis.

Let FB be a perpendicular from the focus upon the Fig. 77.

Parabola.

tangent PB, and FP a straight line drawn to the point of contact; let A be the vertex of the axis, and therefore FA equal to one-fourth of the parameter of the axis; FB is a mean proportional between FP and FA.

Produce FB and FA to meet the directrix in D and C, and join AB. The lines FC, FD, are bisected at A and B (Cor. Def. 1.—3. and 1. Cor. 6.); therefore, (2. 6. E.) AB is parallel to CD, or perpendicular to CF, and consequently a tangent to the curve at A (3. Cor. 2.); now BP is a tangent at P, therefore the angle AFB is equal to BFP (7.), and since the angles FAB, FBP, are right angles, the triangles FAB, FBP, are equiangular; hence FP : FB :: FB : FA.

Cor. 1. The common intersection of a tangent and a perpendicular from the focus to the tangent, is in a straight line touching the parabola at its vertex.

Cor. 2. If PH be drawn perpendicular to the tangent, meeting the axis in H, and HK be drawn perpendicular to PF, PK shall be equal to half the parameter of the axis. For the triangles HPK, PFB are manifestly equiangular; therefore HP : PK :: PF : FB :: FB : FA :: FD : FC. But if PD be joined, the line PD is evidently perpendicular to the directrix (6.); therefore the figure HPDF is a parallelogram, and HP = FD; therefore PK = FC = half the parameter of the axis.

Prop. XV. *Problem.*

A parabola being given by position, to find its directrix and focus.

Fig. 78. Let DPd be the given parabola; draw any two parallel chords Dd, Ee, and bisect them at H and K; join KH, meeting the parabola in P; the straight line PHK is a diameter (4 Cor. 9.), the point P is its vertex, and Dd, Ee are ordinates to it. In HP produced take PL, equal to one-fourth part of a third proportional to PH and HD, and draw LN perpendicular to PL, the line LN will evidently be the directrix (Def. 10. & Prop. 13.) Draw PM parallel to the ordinates to the diameter PK, then PM will be a tangent to the curve at P (2. Cor. 9.) Draw LM perpendicular to PM, and take MF = ML, and the point F will be the focus of the parabola, (1. Cor. 6.)

SECTION V.

Of the Curvature of the Conic Sections.

Definitions.

1. A circle is said to *touch* a conic section in any point, when the circle and conic section have a common tangent in that point.

2. If a circle touch a conic section in any point, so that no other circle touching it in the same point can pass between it and the conic section on either side of the point of contact, it is said to have the *same curvature* with the conic section in the point of contact, and it is called the *Circle of Curvature.*

Lemma.

Fig 79. Let PK be any chord in a circle, PX a tangent at one of its extremities, and KL a diameter passing through the other extremity; draw any chord Hh parallel to the tangent, meeting PK in E, and from its extremities draw HG, hg perpendicular to the diameter, meeting PK in M and m; the square of HE is equal to the rectangle contained by PE and KM, and the square of hE is equal to the rectangle contained by PE and Km.

Curvature.

From H and h draw the straight lines HP, hP, HK, hK, and let KN a perpendicular to the diameter, and therefore a tangent to the circle at K, meet PX in N. The triangle MHE is evidently similar to the triangle KNP, and KN = NP, therefore MH = HE; hence the angles HMK, HEP are equal. Now, PHE is equal to the alternate angle HPX, that is, to the angle HKM in the alternate segment of the circle (32. 3. E.), therefore the triangles PHE, HKM are similar, and PE : EH :: HM or EH : MK, therefore $HE^2 = PE.MK$. In the same way it may be demonstrated, that $mh = h$E, and that the triangles PhE, hKm are similar, and therefore PE : Eh :: hm or Eh : mK, and hence $hE^2 = PE.mK$.

Prop. I.

If a circle be described touching a conic section, and cutting off from the diameter that passes through the point of contact a segment greater than the parameter of that diameter, a part of the circumference on each side of the point of contact will be wholly without the conic section; but if it cuts off from the diameter a segment less than the parameter, a part of the circumference on each side of the point of contact will be wholly within the conic section.

Figs. 80, 81, 82, 83. Let Pp be the diameter of a conic section; let a circle HPh touch the section in P, the vertex of the diameter, and cut off a segment PK either greater or less than the parameter of the diameter: In the former case, a part HPh of the circumference of the circle on each side of P, the point of contact, will be wholly without the conic section, as in Fig. 80. and Fig. 81; and in the latter, a part HPh of the circumference on each side of P will be wholly within the section, as in Fig. 82. and Fig. 83. Through K, draw KL a diameter of the circle; let DEd, an ordinate to the diameter of the section, meet the circle in H and h, so that the points H, P, h may be on the same side of KL, the diameter of the circle, and draw HG, hg, PO perpendicular to KL, the two former lines meeting KP in M and m. From K, towards P, place KR in the diameter equal to its parameter: then, in the former case, the point R will fall between K and P, as in Fig. 80. and Fig. 81; and in the latter, it will fall in KP produced, as in Fig. 82. and Fig. 83.

Case 1. First, let the section be a parabola (Figs. 80. and 82.); then DE^2, also $dE^2 = PE.RK$ (Prop. 13. of Sect. IV.): Now $HE^2 = PE.KM$, and $hE^2 = PE.Km$ (Lemma): Therefore $DE^2 : HE^2 :: KR : KM$, and $dE^2 : hE^2 :: KR : Km$. Now, if the ordinate Dd be supposed to approach to the tangent at the vertex, the points H, h will approach to P, the lines HG, hg to the line PO, and the points M, m to the vertex P, where they will at last coincide; hence it is evident, that the ordinate DEd may be at such a distance from the tangent, that the points M, m, and the vertex P, may be all on the same side of the point R. In this position of the ordinate, if the segment cut off by the circle be greater than the parameter, as in Fig. 80, then KR will be less than either KM or Km, and therefore DE^2 less than HE^2, also dE^2 less than hE^2; so that the points H, h are both without the parabola. If the ordinate approach nearer to the tangent, as the points M, m will also approach nearer to P, the line KR will still be less than either KM, or Km, and therefore DE^2 less than HE^2, and dE^2 less than hE^2. Hence, every point

Curvature. in the arch HPh, which lies on each side of the point of contact, is wholly without the parabola.

If the segment cut off by the circle be less than the parameter (Fig. 82.), and therefore KR greater than either KM or Km, then, reasoning as before, it will appear that DE^2 is greater than HE^2, and dE^2 greater than hE^2, so that the points H, h are within the parabola; and as the same will hold for every other position of the ordinate nearer to the tangent, the arch HPh, which lies on each side of the point of contact, is wholly within the parabola.

Case 2. Next, let the section be an ellipse, or an hyperbola, (Fig. 81, 83.) * Take V a point in KR, so that $pP : pE :: KR : KV$, and therefore $Pp : KR :: pE : KV :: pE.EP : KV.EP$. But $Pp : KR :: pE.EP : DE^2$ or dE^2 (18. Sect. II. and 26. Sect. III.); therefore DE^2, also $dE^2 = KV.EP$. Now $HE^2 = KM.EP$, and $hE^2 = Km.EP$ (Lemma), therefore $DE^2 : HE^2 :: KV : KM$, and $dE^2 : hE^2 :: KV : Km$. Now, as Pp and RK are similarly divided at E and V, if E approach to P, the point V will approach to R, and as E may come nearer to P than any assignable line, so V may come nearer to R than any assignable line; but as then HG and hg will approach to PO, and M and m to P, it is evident that the ordinate Dd may have such a position, that the points M, m and the vertex P may be all on the same side of V, and the same thing may have place for every other position of the ordinate nearer to the tangent: therefore, in these circumstances, when KP, the segment cut off from the diameter, is greater than KR the parameter (Fig. 81.), KV will be less than either KM or Km, and consequently DE^2 less than HE^2, and dE^2 less than hE^2; thus the points H, h, as well as every other point in the arch HPh, which lies on both sides of the vertex, are without the ellipse or hyperbola. On the contrary, when KP is less than KR, the parameter (Fig. 83.), KV will be greater than either KM or Km, and therefore DE^2 greater than HE^2, also dE^2 greater than hE^2, and therefore the points H, h, as well as every other point in the arch HPh, are within the ellipse or hyperbola.

Cor. 1. If a circle touch a conic section, and cut off from the diameter that passes through the point of contact a segment equal to its parameter, it will have the same curvature with the conic section in the point of contact. For if a greater circle be described, it will cut off from the diameter a segment greater than its parameter, therefore a part of its circumference on each side of the point of contact will be wholly without the conic section; and as it will also be without the former circle, it will not pass between that circle and the conic section at the point of contact. If a less circle be described, it will cut off from the diameter a segment less than its parameter; therefore a part of its circumference on each side of the point of contact will fall within the conic section; and as it will be within the former circle, it will not pass between that circle and the conic section at the point of contact. Hence (Def. 2.) the circle which cuts off a segment equal to the parameter, is the circle of curvature.

Cor. 2. Only one circle can have the same curvature with a conic section in a given point.

Prop. II.

The circle of curvature at the vertex of the axis of a parabola, or at the vertex of the transverse axis of an ellipse or hyperbola, falls wholly within the conic section; but the circle of curvature at the vertex of the conjugate axis of an ellipse, falls wholly without the ellipse. Curvature.

Let Pp be the axis of a parabola (Fig. 84.), and $PHKh$ the circle of curvature at its vertex, which therefore cuts off from the axis a segment PK equal to the parameter of the axis; because the tangent at the vertex is common to the parabola and circle, the centre of the circle is in Pp. Let DEd, an ordinate to the axis, meet the circle in H and h; it may be shewn, as in the last proposition, that $DE^2 : HE^2 :: KP : KE$. But in every position of the ordinate, KP is greater than KE, therefore DE^2 is always greater than HE^2, and dE^2 greater than hE^2; therefore the circle is wholly within the parabola. Next let Pp be the transverse axis of an ellipse or hyperbola (Fig. 85, 86.), or the conjugate axis of an ellipse (Fig. 87.), and $PHKh$ the circle of curvature, then, as in the parabola, the centre of the circle will be in the axis. Draw Dd an ordinate to the axis, meeting the circle in H, h, and take a point V in PK, so that $pP : pE :: KP : KV$, then it will appear as in last Prop. that $DE^2 : HE^2 :: KV : KE$. Now, when Pp is the transverse axis of an ellipse (Fig. 85.), as Pp is greater than KP, and $Pp : PK :: PE : PV$; therefore PE is greater than PV, and hence KV is always greater than KE. Therefore DE^2 is greater than HE^2, also dE^2 greater than hE^2, so that the circle falls wholly within the ellipse. Again, when Pp is the transverse axis of an hyperbola (Fig. 86.) as pE is greater than pP, therefore KV is greater than KP, and consequently greater also than KE; hence DE^2 is greater than HE^2, and dE^2 is greater than hE^2, and the circle is wholly within the hyperbola. Lastly, when Pp is the conjugate axis of an ellipse (Fig. 87.), as Pp is less than KP, and $Pp : KP :: PE : PV$, therefore PE is less than PV; hence KV is less than KE, and consequently DE^2 is less than HE^2; also dE^2 less than hE^2, therefore the circle is wholly without the ellipse. Figs. 84, 85, 86, 87.

Prop. III.

The circle of curvature at the vertex of any diameter of a conic section which is not an axis, meets the conic section again in one point only, and between that point and the vertex of the diameter the circle falls wholly within the conic section on the one side, and wholly without it on the other.

Case I. Let the section be a parabola, of which Pp is a diameter (Fig. 88.), and PKL the circle of curvature at the vertex, cutting off from the diameter a segment PK equal to its parameter. Draw KL a diameter of the circle, and draw PO perpendicular to KL, this line will necessarily meet the circle again, let it meet the circle in I; draw IS parallel to the tangent at P, meeting the chord PK in S; then because IP is perpendicular to KL; $IS^2 = PS.PK$ (Lemma); hence (Prop. 13. Sect. IV.) I is a point in the parabola. Let DEd, an ordinate to the diameter Pp, meet the arch PKI any where in H; draw HG perpendicular to KL, meeting PK in M, then because KP is equal to the parameter, as in Prop. 1. Case 1. $DE^2 : HE^2 :: KP : KM :: KO : KG$. But wherever the point H be taken in the arch PKI, KO is greater than KG, therefore DE^2 is also greater than HE^2; thus the arch PHKI falls wholly within the parabola. Fig. 88.

* As the reasoning applies alike to the ellipse and the hyperbola, to avoid a number of figures, those for the hyperbola are omitted.

Let the ordinate DEd now meet the arch PLI any where as at h, draw hg perpendicular to KL, meeting KP in m, then it will appear as before that $dE^2 : hE^2 :: KP : Km :: KO : Kg$; but KO is less than Kg, and therefore dE^2 is less than hE^2, thus the arch $PhLI$ falls wholly without the parabola.

Fig. 89. CASE 2. Let the section be either an ellipse or hyperbola, of which Pp is a diameter, and PKL the circle of curvature at its vertex, cutting off PK equal to its parameter. Draw KL the diameter of the circle, and KQ perpendicular to KL, and let pQ, a tangent to the conic section in p, meet KQ in Q. Join PQ; this line will necessarily meet the circle again; let it meet the circle in I; and draw IS, IT parallel to Qp, QK meeting PK in S, T. Then because of the parallels, $pP : pS :: QP : QI :: KP : KT$, hence $pP : KP :: pS : KT :: pS.SP : KT.SP$; but $KT.SP = IS^2$ (Lemma) therefore $pP : KP :: pS.SP : SI^2$, hence I is a point in the ellipse or hyperbola. (Prop. 18. Sect. II. and 26. Sect. III.)

Let DEd an ordinate to the diameter Pp meet the arch PLKI any where in H, if the point K is between P and p, or the arch PHI, if K is in pP produced. Let Dd meet PI in Y, draw HG perpendicular to KL, meeting PK in M, and PI in Z, and draw YV parallel to HM, meeting KP in V. Because EY, pQ are parallel, also VY, KQ; $Pp : pE :: (QP : QY ::)\ KP : KV$; now KP being the parameter, we have, as in Case 2. Prop. 1. $DE^2 : HE^2 :: KV : KM :: QY : QZ$; but wherever the point H be taken in the arch PHI, QY is greater than QZ, therefore also DE^2 is greater than HE^2; thus the arch PHI falls wholly within the conic section.

Let the ordinate DEd now meet the other arch PhI any where in h; draw hg perpendicular to KL meeting KP in m, and IP in z, then it will in like manner appear that $dE^2 : hE^2 :: KV : Km :: QY : Qz$; and since in this case QY is less than Qz, therefore dE^2 is less than hE^2; hence the arch PhI is wholly without the conic section.

PROP. IV.

The chord of the circle of curvature which is drawn from the point of contact through the focus of a parabola, is equal to the chord which the circle cuts off from the diameter of the parabola; and half the radius of the circle is a third proportional to the perpendicular from the focus upon the tangent, and the distance of the point of contact from the focus.

Fig. 90. Let PK be the chord cut off from the diameter, and PFG the chord passing through F, the focus; draw PN the diameter of the circle, join GK, GN, and draw FL perpendicular to the tangent at P. Because the lines PFG, PK make equal aagles with the tangent at P (6. Sect. IV.) the angles PGK, PKG are equal (32. 3. E.); hence $PG = PK$.

Again, the triangles FLP, PGN being manifestly similar, $FL : FP :: PG$ or $4PF : PN$; hence $FL : FP :: FP : \frac{1}{4}PN$ or $\frac{1}{2}$ the radius.

COR. 1. Hence the radius is equal to $\dfrac{2\,FP^2}{FL}$

COR. 2. The radius is also equal to $\dfrac{2\,FL^3}{AF^2}$, where AF is the distance of the focus from the vertex of the parabola; for $FP = \dfrac{FL^2}{AF}$ (14. of Sect. IV.)

COR. 3. Hence also the radius is equal to $\dfrac{\frac{1}{2}L.FP^3}{FL^3}$, where L denotes the parameter of the axis, for $\dfrac{2\,FP^2}{FL}$ $= \dfrac{2\,AF.FP^3}{AF.FP.FL} = \dfrac{\frac{1}{2}L.FP^3}{FL^3}$.

PROP. V.

The radius of the circle of curvature at the vertex of any diameter of an ellipse or hyperbola is a third proportional to the perpendicular drawn from the centre upon the tangent and half the conjugate diameter; and the chord which is drawn from the point of contact through the focus, is a third proportional to the transverse axis and conjugate diameter.

Let PK be the chord cut off from the diameter, and PFG the chord passing through F, the focus; draw PN the diameter of the circle, and from the centre O draw OR perpendicular to PK, which will bisect PK in R; join GN, and draw the conjugate diameter QCq, meeting PG in M, and PN in S, then PS is equal to the perpendicular from the centre C upon the tangent. The triangles PSC, PRO are similar, therefore $PS : PC :: PR : PO$, but $PC : CQ :: CQ : PR$ (Def. of parameter),; therefore $PS : CQ :: CQ : PO$. Fig. 91.

Again, the triangles PSM, PGN are similar; therefore $PM : PS :: PN : PG$, but $PS : CQ :: (CQ : PO ::)\ Qq : PN$, therefore, $PM : CQ :: Qq : PG$, or since $PM = AC$ (Cor. 22. Sect. II. and Cor. 30. Sect. III.) $Aa : Qq :: Qq : PG$.

COR. 1. Hence the radius of curvature is equal to $\dfrac{CQ^2}{PS}$, and the chord passing through the focus is equal to $\dfrac{2\,CQ^2}{AC}$.

COR. 2. The radius of curvature is also equal to $\dfrac{CQ^3}{AC.BC}$, for $PS = \dfrac{AC.BC}{CQ}$. (Prop. 20. Sect. II. and Prop. 28. Sect. III.)

COR. 3. Draw FL from the focus perpendicular to the tangent, and let L denote the parameter of the transverse axis; the radius of curvature is also equal to $\dfrac{\frac{1}{2}L.FP^3}{FL^3}$. For the triangles PFL, MPS are manifestly similar, therefore $FL : FP :: (PS : PM \text{ or } AC ::)\ BC : CQ$; hence $CQ = \dfrac{FP}{FL} \times BC$, and $\dfrac{CQ^3}{AC.BC} = \dfrac{FP^3}{FL^3} \times \dfrac{BC^2}{AC} = \dfrac{FP^3}{FL^3} \times \frac{1}{2}L$.

This expression for the radius of curvature is the same for all the conic sections.

SECTION VI.

OF THE SECTIONS OF A CONE.

Definitions.

1. If ADB be a circle, and V a point out of its plane, both having a fixed position; and if a straight line aVA, indefinitely extended both ways, pass through V, and move in the circumference of the circle; when it has made a complete revolution, it will have gene- Fig. 92.

Sections of a Cone.

rated two superfices which meet at V, and include within them a solid called a *Cone.*

2. The point V is called the *Vertex of the Cone.*

3. The circle ADB is called its *Base.*

4. Any straight line drawn from the vertex of the cone to a point in the circumference of the base is called a *Side of the Cone.*

5. A straight line VC drawn from the vertex to the centre of the base, is called the *Axis of the Cone.*

Cor. Any section of a cone through the axis is a triangle.

Prop. I.

If a cone be cut by a plane parallel to its base, the section is a circle.

Fig. 92.

Let EFGM be the section, and the triangles VAB, VCD two other sections made by any two planes through the axis; let EG, OF be the common sections of these and the section EFG. Then, EO, FO, GO are parallel to AC, DC, BC respectively: therefore $AC : EO\ (:: CV : OV) :: DC : FO$; but $AC = DC$; therefore $EO = FO$; and in like manner it appears that $GO = FO$; therefore EFGM is a circle of which EG is the diameter.

Prop. II.

If a cone be cut by a plane which neither passes through the vertex, nor is parallel to the base, the section will be one or other of these figures, viz. a circle, an ellipse, an hyperbola, or a parabola.

Figs. 92, 93, 94.

Let PX be the common section of the base, and a plane passing through V, the vertex of the cone; and let FKM be a section of the cone parallel to the plane VPX. From C, the centre of the base, draw CN perpendicular to PX; meeting the circumference in A and B; and let a plane pass through V, A, B, and meet the plane XPV in the line NV, the surface of the cone in VA, and VB, and the plane of the section FKM in KL; then because the planes XVP, MKF are parallel, KL is parallel to VN.

Let EFGM be a section of the cone parallel to the base, meeting the plane VAB in EG, and the plane FKM in FM; and let L be the intersection of EG and FM; then EG will be parallel to BN; and FM is parallel to PX, and therefore will make the same angle with LK, wherever the lines FM, LK cut each other; and since BN is perpendicular to PX; EG is perpendicular to FM. Now the section EFGM is a circle, of which EG is the diameter (1.) therefore FM is bisected at L, and $FL^2 = EL.LG$.

Now there will be four cases, resulting from the different positions of the line VN in respect of the cone.

Fig. 92.

Cases 1. and 2. Let the line PNX fall without the base of the cone (Fig. 92.) Then KH will meet the opposite sides in K and H, below the vertex. Draw KR, HQ parallel to AB; then, the triangles KLG, KHQ are similar, as also HLE, HKR; therefore,

$$KL : LG :: KH : HQ,$$

$$\text{and } HL : LE :: KH : KR;$$

therefore taking the rectangles of the corresponding terms,

$$KL.LH : GL.LE \text{ or } LF^2 :: KH^2 : HQ.KR.$$

Now if the angles VKH, VAB are equal, then also $VKH = VRK$, and $HKQ = HRK$; and as the alternate angles RKH, HKQ are equal, the triangles RKH, HKQ are similar, so that $RK : KH :: KH : HQ$, and $HK^2 = HQ.KR$, therefore in this case $KL.LH = LF^2$, and consequently HFK is the circumference of a *circle,* of which KH is the diameter (35. 3. E.)

Areas of the Conic Sections.

Note. This particular section of a cone is called a *Subcontrary Section.*

If, however, the angles VKH, VAB be unequal, then HK^2 will not be equal to HQ.KR, but will have to it the same ratio wherever the point L is situated in the line HK; therefore, in this case KL.LH has a constant ratio to LF^2, and consequently the section HFK is an *ellipse,* of which HK is a diameter, and LF an ordinate (1. Cor. 16. Sect. II.)

Fig. 93.

Case 3. Next let the line PNX fall within the base of the cone, (Fig. 93.) then the plane FKM will meet the base in a line SID, and the line KL will meet AV, the side of the cone, at H a point above the vertex. Draw VT perpendicular to IH, and by similar triangles

$$HT : TV :: LH : LE,$$

$$\text{and } KT : TV :: KL : LG;$$

therefore, $HT.KT : TV^2 :: HL.LK : LE.LG \text{ or } LF^2$. Hence it appears that in this case, HL.LK has to LF^2 a constant ratio; therefore the section DFKMS is an hyperbola, of which KH is a transverse diameter, and FM an ordinate to that diameter. (2. Cor. 24. Sect. III.)

Fig. 94.

Case 4. Lastly, let the line PNX touch the circumference of the base in A, (Fig. 94.) In this case, DIS, the common section of the base and the plane FKM, is evidently parallel to FLM, and perpendicular to AB; therefore $DI^2 = AI.IB$, and $DI^2 : FL^2 :: AI.IB : EL.LG :: IB : LG$. But since EG is parallel to AB, and IK parallel to AV, we have $IB : LG :: KI : KL$; therefore $DI^2 : FL^2 :: KI : KL$; hence it follows that the section DFKMS is a parabola, of which KLI is a diameter, and DIS, FLM ordinates to that diameter. (Cor. to 12. Sect. IV.)

SECTION VII.

Of the Areas of the Conic Sections.

Prop. I.

Fig. 95.

If an ordinate AB, and abscissa PQ of a parabola be completed into a parallelogram ABCD; the area of the parabola included between the ordinate and the curve is two thirds of the parallelogram.

Draw the chords AP, PB; also draw the diameters Ff, Ii, to bisect the semiordinates AQ, QB in f and i, and draw the chords AF, FP, PI, IB. Again, draw the diameters Ee, Gg, Hh, Kk to bisect the distances between the points A, f, Q, i, B, and draw the chords AE, EF, FG, GP, PH, HI, IK, KB; and suppose this operation of drawing diameters to be repeated any number of times. By this process there will be formed successive series of triangles; the first consisting of one term, viz. APB; the second of two, viz. the triangles AFP, PIB; the third of four, viz. AEF, FGP, PHI, IKB, and so on.

Let Ff meet PD in M, and the chord PA in N; and because PA is manifestly an ordinate to the diameter Ff, (Def. 8. Sect. IV.) and PM a tangent, at the extremity of the ordinate; $FN = \frac{1}{2} MN$; but because $PM = Af$, it follows that $MN = Nf = \frac{1}{2} PQ$; therefore $FN = \frac{1}{4} PQ$. Now the triangles AFP, AQP, which have the same base AP, being to each other as their alti-

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tudes; they will also be to one another as FN to QP, which making equal angles with the common base, have the same ratio as the altitudes; therefore the triangle AFP is $\frac{1}{4}$ of the triangle APQ; and as in like manner it may be shewn that the triangle BIP is $\frac{1}{4}$ of the triangle BPQ; the triangles AFP, BIP are together $\frac{1}{4}$ of the triangle APB.

If a tangent be drawn at F, and produced to meet the two diameters E*e*, G*g*, it may be proved in the same manner, that the triangles AEF, PGF are the fourths of the triangles AFN, PFN, and therefore, that their sum is $\frac{1}{4}$ of the triangle AFP; and as it may also be shewn that the triangles PHI, BKI are together equal to $\frac{1}{4}$ of the triangle PIB, the four triangles AEF, FGP, PHI, IKB are together $\frac{1}{4}$ of the sum of the triangles AFP, PIB. Proceeding in this way, it appears that at every succeeding bisection, a new set of triangles is produced, which together are $\frac{1}{4}$ of the area of the preceding set.

Put S for the area of the parallelogram ADCB, then we have

Triangle $APB=\frac{1}{2}S$,

Polygon $AFPIB=(\frac{1}{2}+\frac{1}{8})S$,

Polygon $AEFGPHIKB=(\frac{1}{2}+\frac{1}{8}+\frac{1}{32})S$.

From the law according to which the terms in these numerical series are formed, it is evident that whatever be the number of sides of the polygon inscribed in the parabola, its area will be expressed by the geometrical series $(\frac{1}{2}+\frac{1}{8}+\frac{1}{32}+\frac{1}{64}+ \&c.)\ S$, the number of terms depending on the number of sides of the polygon. Suppose now the number of sides to be continually increased, then its area will manifestly approach continually to the area of the parabola, which is its limit, and will at last differ from it by less than any assignable space. Therefore the area of the parabola is exactly equal to the product of S, by the fraction which expresses the sum of the geometrical series continued indefinitely; now, observing that the first term is $\frac{1}{2}$, and common ratio $\frac{1}{4}$, the sum is readily found by a known formula to be $\frac{2}{3}$, (See Algebra, Art. 207.) therefore the area of the parabola is $\frac{2}{3}$ of the parallelogram ABCD.

Definition.

If the two axes of an hyperbola be equal, it is called an *Equilateral Hyperbola.*

Prop. II.

Fig. 96, 97. Let C be the centre of a circle, or of an equilateral hyperbola, and CA the semitransverse axis; let ACB, BCD be two equal sectors of the circle, or hyperbola, and let AHK, a tangent at the vertex A, meet the semidiameters CB, CD in H and K; then,

in the circle, $2\,CA : AK :: CA^2-AH^2 : CA.AH$,

and in the hyperbola, $2\,CA : AK :: CA^2+AH^2 : CA.AH$.

For draw DA, D*a* to the extremities of the axis; let the chord DA meet the semidiameter CB in O, and draw DE perpendicular to the axis; and because AO=OD, (Geometry, and Prop. 34. Part III.) and AC=C*a*, the line CO, *a* D are parallel (2. 6. E.) therefore the triangles CAH, *a*ED are similar; but because $ED^2=AE.Ea$ (Prop. 24. of Part III.) $AE:ED::ED:Ea$ (16. 6. E.) hence the triangles DEA, *a* ED are similar, (6. 6. E.) and each is similar to CAH; therefore

$Ea : ED :: AC : AH :: AC^2 : AC.AH$,

$EA : ED :: AH : AC :: AH^2 : AC.AH$,

Hence in the circle,

$Ea-EA$ or $2\,CE : ED :: AC^2-AH^2 : AC.AH$;

and in the hyperbola, (24. 5. E.)

$Ea+EA$ or $2\,CE : ED :: AC^2+AH^2 : AC.AH$.

But $2\,CE : ED :: 2\,CA : AK$

therefore $2\,CA : AK :: AC^2 \mp AH^2 : AC.AH$.

Prop. III.

If two ellipses, or two hyperbolas, have a common axis A *a*, and a semiordinate DD′E be drawn from the same point E in the axis, to each of the curves; the areas ADE, AD′E included between the common abscissa, the ordinates, and the two curves are to one another as the conjugate axes BC, B′C. Fig. 98, 99.

Let the common abscissa AE be divided into any number of equal parts A*p*, *p q*, *q* E; draw the semiordinates *p m′ m*, *q n′ n*, and the chords A *m*, *m n*, *n* D, also A *m′*, *m′ n′*, *n′* D′. And because $BC^2 : DE^2$ (:: $AC.Ca : AE.Ea$) :: $B'C^2 : D'E^2$ (1. Cor. 16. Part II, and 2. Cor. 24. Part III.), therefore $BC : DE :: B'C : D'E$, and $BC : B'C :: DE : D'E$; in like manner it appears that $BC : B'C :: nq : n'q :: mp : m'p$. Now, the triangle A *p m* is to the triangle A *p m′* as *m p* to *m′ p*, that is, as BC to B′C; and the trapezoid *p m n q* is evidently to the trapezoid *p m′ n′ q*, also the trapezoid *q n* DE to the trapezoid *q n′* D′E in the same ratio; therefore the polygon A *m n* DE is to the polygon A *m′ n′* D′E also as BC to B′C: and this will be true, whatever be the number of equal parts into which the common abscissa AE is divided. Suppose, now, that number to be indefinitely increased, then it is evident that the polygons will approach continually to the elliptic, or hyperbolic areas in which they are inscribed, so as at last to differ from them by less than any assignable space; therefore the elliptic, or hyperbolic spaces themselves, which are the limits of the polygons, are also to one another as BC to B′C.

Cor. 1. Hence it appears, that the area of an ellipse is to that of its circumscribing circle, as the conjugate axis to the transverse axis. For a circle may be considered as an ellipse having its axes equal.

Cor. 2. It also appears, that the area of any segment of an ellipse may be found from that of a corresponding segment of a circle: And the area of any hyperbolic segment from the corresponding segment of an equilateral hyperbola, having the same transverse axis.

Prop. IV. *Problem.*

To investigate a formula that shall express the area of a circle, or equilateral hyperbola.

Let ACD be a sector of a circle or hyperbola, and AC the radius of the circle, or semitransverse axis of the hyperbola. Let the sector be bisected by the semidiameter CB, and let each of the sectors ACB, BCD be bisected by the semidiameters CP, CQ; and proceed in this way, by repeated bisections, to divide the whole sector first into two equal parts, then into four, then into eight, and so on. Draw tangents to the curves at the alternate points A, B, D; and because, from the nature of the curves, the chords which join these points are ordinates to the semidiameters CP, CQ, which pass between them, the tangents will intersect each other at G, L, points in the semidiameters (1. Cor. Prop. 13. Sect. III.) Draw the chord AB joining any two contiguous points of contact, and let it meet CP in I; and because the triangles ACI, BCI are equal (38. 1. E.), as also the triangles AGI, BGI, by Fig. 100, 101.

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adding in Fig. 100, and subtracting in Fig. 101, the triangles CAG, CBG are equal: In the same way it appears, that the triangles DCL, BCL are equal. Again, because the semidiameter CB bisects the chord which joins P and Q, it will bisect GL, the tangent which is parallel to that chord; and therefore the triangles GCB, LCB are equal. Hence it follows, that the triangles ACG, GCB, BCL, LCD, are all equal; and this will be true, whatever be their number.

Let AK, a tangent at the vertex A, meet the semidiameters CP, CB, CD in G, H, K: Put the letter a to denote the semitransverse axis CA; and let the tangents AK, AH, AG, &c. which correspond to the whole sector, its half, its fourth, &c. be denoted by t, t', t'', &c. respectively: And because (by Prop. 2.) $2a:t::a^2\mp t'^2:at'$: (where the upper sign applies to the circle, and the lower to the hyperbola) we have $\frac{a^2}{t}=\frac{a^2}{2t'}\mp\frac{t'}{2}$; but as similarly $\frac{a^2}{t'}=\frac{a^2}{2t''}\mp\frac{t''}{2}$, we have, by substitution, $\frac{a^2}{t}=\frac{a^2}{4t''}\mp\left(\frac{t'}{2}+\frac{t''}{4}\right)$, and hence $\frac{a^3}{4at''}=\frac{a^2}{t}\pm\left(\frac{t'}{2}+\frac{t''}{4}\right)$. Now the expression $4at''$ or 4CA $\times$ AG (see Fig. 100. and 101.) is eight times the triangle ACG, that is double the polygon CAGBLD which circumscribes the circular, or is inscribed in the hyperbolic sector; therefore putting s' to denote the polygon, we have

$$\frac{a^3}{2s'}=\frac{a^2}{t}\pm\left(\frac{t'}{2}+\frac{t''}{4}\right).$$

If we carry on the process of bisecting the sector ACD indefinitely, so as to divide it next into 8, then into 16, then into 32 equal parts, and so on, and put t''' for the tangent corresponding to its 8th part, and t^{iv} for that corresponding to its 16th part, &c. we shall have in like manner,

$$\frac{a^3}{2s'}=\frac{a^2}{t}\pm\left(\frac{t'}{2}+\frac{t''}{4}+\frac{t'''}{8}+\frac{t^{\text{iv}}}{16}+, \text{ \&c.}\right)$$

Now the polygon CAGBLD manifestly approaches continually to the area of the sector, as the number of its sides is increased, and at last differs from it by less than any assignable quantity; therefore, putting now s for the area of the sector, if we substitute s in the above expression instead of s', and conceive the series of terms $\frac{t'}{2}$, $\frac{t''}{4}$, &c. to be continued *ad infinitum*, we have the quantity $\frac{a^3}{2s}$ expressed by an infinite series, from which we readily find

$$2s=\frac{a^3t}{a^2\pm t\left(\frac{t'}{2}+\frac{t''}{4}+\frac{t'''}{8}+, \text{ \&c.}\right)}$$

the formula to be investigated, and in which it must be observed, that the upper part of the sign $\pm$ applies to the circle, and the lower to the hyperbola.

As to the successive quantities t', t'', t''', &c. they may be determined from each other, and from t, by the series of formulas $2a^2t'=t\,(a^2\mp t'^2)$, $2a^2t''=t'\,(a^2\mp t''^2)$ &c. for it will be found by resolving a quadrate equation, that in the case of the circle,

$$t'=a\left\{\sqrt{\frac{a^2}{t^2}+1}-\frac{a}{t}\right\}:$$

but in the case of the hyperbola,

$$t'=a\left\{\frac{a}{t}-\sqrt{\frac{a^2}{t^2}-1}\right\};$$

and in the latter case the least root is taken, because t' ought to be less than t. The value of t'', t''', &c. are found each from that before it exactly as t' is found from t.

Scholium.

The formula for the determination of the tangents t', t'', t''', &c. each from that before it, in the case of the hyperbola, is entirely similar to that for the circle, differing from it only in the signs of the terms In the hyperbola, however, these tangents have a property which does not belong to them in the circle, by which their calculation may be facilitated: For since in the hyperbola

$$a:t::a^2+t'^2:2at', \text{ (by Prop. 2.)}$$

by mixing,

$$a+t:a-t::a^2+2at'+t'^2:a^2-2at'+t'^2;$$

that is, $a+t:a-t::(a+t')^2:(a-t')^2$;

and because, similarly,

$$a+t':a-t'::(a+t'')^2:(a-t'')^2,$$

and therefore

$$(a+t')^2:(a-t')^2::(a+t'')^4:(a-t'')^4;$$

therefore $a+t:a-t::(a+t'')^4:(a-t'')^4$;

and so on: Hence,

$$\frac{a+t'}{a-t'}=\left(\frac{a+t}{a-t}\right)^{\frac{1}{2}},$$

$$\frac{a+t''}{a-t''}=\left(\frac{a+t'}{a-t'}\right)^{\frac{1}{2}},$$

$$\frac{a+t'''}{a-t'''}=\left(\frac{a+t''}{a-t''}\right)^{\frac{1}{2}}, \text{ \&c.}$$

Let us now put $\frac{a+t}{a-t}=v$, then $\frac{a+t'}{a-t'}=v^{\frac{1}{2}}$, $\frac{a+t''}{a-t''}=v^{\frac{1}{4}}$, &c. therefore, resolving these equations in respect of t', t'', &c. we find $t'=a\frac{v^{\frac{1}{2}}-1}{v^{\frac{1}{2}}+1}$, $t''=a\frac{v^{\frac{1}{4}}-1}{v^{\frac{1}{4}}+1}$, $t'''=a\frac{v^{\frac{1}{8}}-1}{v^{\frac{1}{8}}+1}$, &c. This series of fractions, by which the tangents t', t'', &c. is expressed, being formed in a very simple manner from the square, the fourth, the eighth, &c. root of the fraction $v=\frac{a+t}{a-t}$, they may be easily computed, and thence the values of t', t'', &c. and sector s, found.

The tangents t', t'', &c. may also be readily found from the trigonometrical tables, for each is related to that which follows it, exactly as the sine of an angle to the tangent of half that angle. This may be proved as follows:

Put u and z to denote any two angles, then it appears, from the third and fourth formulas of Table D, Art. 12, Arithmetic of Sines, that

$$\frac{\text{Sin. }u+\text{Sin. }z}{\text{Sin. }u-\text{Sin. }z}=\frac{\text{Sin. }\frac{1}{2}(u+z)\text{ Cos. }\frac{1}{2}(u-z)}{\text{Cos. }\frac{1}{2}(u+z)\text{ Sin. }\frac{1}{2}(u-z)},$$

$$=\frac{\text{Tan. }\frac{1}{2}(u+z)}{\text{Tan. }\frac{1}{2}(u-z)}.$$

Now, by Art. 26,

$$\text{Tan. }\tfrac{1}{2}(u+z)=\frac{\text{Tan. }\frac{1}{2}u+\text{Tan. }\frac{1}{2}z}{1-\text{Tan. }\frac{1}{2}u\text{ Tan. }\frac{1}{2}z},$$

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$$\text{Tan.}\ \tfrac{1}{2}(u-z)=\frac{\text{Tan.}\ \frac{1}{2}u-\text{Tan.}\ \frac{1}{2}z}{1+\text{Tan.}\ \frac{1}{2}u\ \text{Tan.}\ \frac{1}{2}z},$$

therefore,

$$\frac{\text{Sin.}\ u+\text{Sin.}\ z}{\text{Sin.}\ u-\text{Sin.}\ z}=$$

$$\frac{(\text{Tan.}\ \frac{1}{2}u+\text{Tan.}\ \frac{1}{2}z)\ (1+\text{Tan.}\ \frac{1}{2}u\ \text{Tan.}\ \frac{1}{2}z)}{(\text{Tan.}\ \frac{1}{2}u-\text{Tan.}\ \frac{1}{2}z)\ (1-\text{Tan.}\ \frac{1}{2}u\ \text{Tan.}\ \frac{1}{2}z)}.$$

Suppose now that u is a right angle, so that Sin. $u=1$, and Tan. $\frac{1}{2}u=1$. In this case the formula becomes

$$\frac{1+\text{Sin.}\ z}{1-\text{Sin.}\ z}=\frac{(1+\text{Tan.}\ \frac{1}{2}z)^2}{(1-\text{Tan.}\ \frac{1}{2}z)^2}.$$

By comparing this formula with those which express the relation of t, t', t'', &c. to each other, viz.

$$\frac{1+\frac{t}{a}}{1-\frac{t}{a}}=\frac{\left(1+\frac{t'}{a}\right)^2}{\left(1-\frac{t'}{a}\right)^2},\qquad \frac{1+\frac{t'}{a}}{1-\frac{t'}{a}}=\frac{\left(1+\frac{t''}{a}\right)^2}{\left(1-\frac{t''}{a}\right)^2},\ \text{\&c.}$$

it will immediately appear, that the relation of $\frac{t}{a}$ to $\frac{t'}{a}$, also of $\frac{t'}{a}$ to $\frac{t''}{a}$, &c. is the very same as that of Sin. z to Tan. $\frac{1}{2}z$.

Hence it follows, that if we find from the trigonometrical tables the series of sines

Sin. z, Sin. z', Sin. z'', &c.

such that

$$\text{Sin.}\ z=\frac{t}{a},\ \text{Sin.}\ z'=\text{Tan.}\ \tfrac{1}{2}z,\ \text{Sin.}\ z''=\text{Tan.}\ \tfrac{1}{2}z',\ \text{\&c.}$$

and suppose s to express, as before, the hyperbole sector, then

$$2s=\frac{a^2 t}{a-t\ (\frac{1}{2}\ \text{Sin.}\ z'+\frac{1}{4}\ \text{Sin.}\ z''+\frac{1}{8}\ \text{Sin.}\ z'''+,\ \text{\&c.})}$$

The series in the denominator evidently approaches continually to a geometrical series, of which the common ratio is $\frac{1}{4}$; and because, in an infinite geometrical progression, whose common ratio is $\frac{1}{4}$, the sum of all the terms following any assigned term is exactly $\frac{1}{3}$ of that term, therefore any term of the series will be nearly triple of the sum of all that follow it, and this will be more nearly true as the term is farther from the beginning; the same also holds true of the series for the circle.

Prop. V. *Problem.*

Figs. 100, 101. To investigate a second formula that shall express the area of a circle or equilateral hyperbola.

Let the letters a, t, t', t'', &c. and s', s denote the same things as in last Proposition. Then because

$$\frac{a^2}{t}=\frac{a^2}{2t'}\mp\frac{t'}{2},$$

by taking the square of each side of the equation, we obtain

$$\frac{a^4}{t^2}=\frac{a^4}{4t'^2}+\frac{t'^2}{4}\mp\frac{a^2}{2};$$

and similarly we have

$$\frac{a^4}{t'^2}=\frac{a^4}{4t''^2}+\frac{t''^2}{4}\mp\frac{a^2}{2};$$

therefore, by substituting this value of $\frac{a^4}{t'^2}$ in the preceding equation, and taking the value of the term $\frac{a^4}{16t''^2}$, and also multiplying its numerator and denominator by a^2, we get

$$\frac{a^6}{16a^2t''^2}=\frac{a^4}{t^2}-\left(\frac{t'^2}{4}+\frac{t''^2}{4^2}\right)\pm a^2\left(\frac{1}{2}+\frac{1}{2.4}\right).$$

Now, $a t''$, being the numerical expression for the double of the triangle CAG, and $2at''$ that of the polygon s', and consequently, $16a^2t''^2$ that of $4s'^2$, we have only to substitute $4s'^2$ in the denominator of the first member of the equation, and the result will be an expression from which s' may be found; but as the terms of this expression will follow the same law, whatever be the number of quantities t', t'', &c. we have universally

$$\frac{a^6}{4s'^2}=\begin{cases}\frac{a^4}{t^2}-\left(\frac{t'^2}{4}+\frac{t''^2}{4^2}+\frac{t'''^2}{4^3}+,\ \text{\&c.}\right)\\ \pm a^2\left(\frac{1}{2}+\frac{1}{2.4}+\frac{1}{2.4^2}+,\ \text{\&c.}\right),\end{cases}$$

the two series being supposed continued to any extent whatever. Let us now suppose the series of quantities t, t', t'', t''', &c. to be continued indefinitely, then the numerical series $\frac{1}{2}+\frac{1}{2.4}+\frac{1}{2.4^2}+$, &c. being an infinite geometrical progression, whose common ratio is $\frac{1}{4}$, its sum will be $\frac{2}{3}$, and the limit of s' being s, we have

$$\frac{a^6}{4s^2}=\begin{cases}\frac{a^4}{t^2}\pm\frac{2}{3}a^2\\ -\left(\frac{t'^2}{4}+\frac{t''^2}{4^2}+\frac{t'''^2}{4^3}+,\ \text{\&c.}\right)\end{cases}$$

Let this equation be now resolved in respect of s^2, then extracting the square root, and putting

$$\text{T}=\frac{t'^2}{4}+\frac{t''^2}{4^2}+\frac{t'''^2}{4^3}+,\ \text{\&c.}$$

we have

$$2s=\frac{a^3t}{\sqrt{(a^4\pm\frac{2}{3}a^2t^2-t^2\text{T})}}$$

the formula to be investigated, and in which it must be observed, that the sign of the second term of the radical in the denominator is + for the circle and — for the hyperbola.

To determine the quantities t'^2, t''^2, &c. we have, from Prop. 2.

$$a:t::a^2\mp t'^2:2at',$$

the upper part of the sign $\mp$ applying to the case of the circle, and the lower to the hyperbola. Hence, in the former case, we have, by taking the squares

$$a^2:t^2::a^4-2a^2t'^2+t'^4:4a^2t'^2,$$

and, by conversion,

$$a^2:a^2+t^2::a^4-2a^2t'^2+t'^4:a^4+2a^2t'^2+t'^4;$$

therefore, taking the square roots,

$$a:\sqrt{(a^2+t^2)}::a^2-t'^2:a^2+t'^2,$$

and, by mixing,

$$\sqrt{(a^2+t^2)}+a:\sqrt{(a^2+t^2)}-a:2a^2:2t'^2::a^2:t'^2,$$

hence we find for the circle,

$$t'^2=\frac{a^2\left(\sqrt{(a^2+t^2)}-a\right)}{\sqrt{(a^2+t^2)}+a};$$

and, by proceeding in the very same manner it will appear, that in the hyperbola,

$$t'^2=\frac{a^2\left\{a-\sqrt{(a^2-t^2)}\right\}}{a+\sqrt{(a^2-t^2)}}$$

The quantities t''^2, t'''^2, &c. are derived each from that before it, exactly as t'^2 is from t^2.

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Scholium.

If, in the case of the circle, we denote the angle ACD by u, then $t = a \tan. u$, $\sqrt{(a^2+t^2)} = a \sec. u = \frac{a}{\cos. u}$, $\sqrt{(a^2+t^2)} - a = \frac{a(1-\cos. u)}{\cos. u}$, $\sqrt{(a^2+t^2)} + a = \frac{a(1+\cos. u)}{\cos. u}$; therefore,

$$t'^2 = a^2 \frac{1-\cos. u}{1+\cos. u},$$

$$t''^2 = a^2 \frac{1-\cos. \frac{1}{2}u}{1+\cos. \frac{1}{2}u},$$

$$t'''^2 = a^2 \frac{1-\cos. \frac{1}{4}u}{1+\cos. \frac{1}{4}u}, \text{ \&c.}$$

In this manner the quantities t'^2, t''^2, &c. may be readily formed from the cosines of the submultiples of the angle u; and these may be derived one from another by the formula $\cos. \frac{1}{2}u = \sqrt{\left(\frac{1+\cos. u}{2}\right)}$. A similar transformation may be made in the series T in the case of the hyperbola; also the quantities t'^2, t''^2, &c. may in this case be found from the trigonometrical tables, by considering, that if $\text{Sin.}\, z = \frac{t}{a}$, then $t'^2 = \text{Tan.}^2 \frac{1}{2} z$, &c. (Scholium to last Prop.) The series T, in this formula, converges more rapidly than that in the last, the terms approximating continually to those of a geometrical series, of which the common ratio is $\frac{1}{16}$; from which it follows, that the sum of all the terms following any term, is nearly $\frac{1}{15}$ of that term; and this is more nearly true, as the term is more advanced in the series.

By the same mode of deduction, other formulæ for the areas of a circle and hyperbola may be found, but for these we refer the reader to a paper in the fifth volume of the *Transactions of the Royal Society of Edinburgh*, by Mr Wallace, of the Royal Military College.

Sect. VIII.

On the Equations of the Conic Sections, and their Identity with Lines of the Second Order.

From the property of the conic sections, which we have employed in their definition, their *polar equation* may be immediately derived. Let us suppose, as in the definitions of Sections II. III. and IV. that the curves are traced by D, the extremity of a variable radius FD, which revolves about F, a fixed point, as a centre. This line has, in the application of the theory of these curves to astronomy, been called the *Radius Vector*. Put r for the line FD, z for the angle DFA, which it makes with the axis; d for FP, the distance of the focus from the directrix; and let the determining ratio be that of 1 to n, a given number. Draw DI perpendicular to the axis, and DE to the directrix; and because Rad. : Cos. z : : FD or r : FI, and $1 : n$: : FD or r : DE or IP, we have $\text{FI} = r \text{ Cos. } z$, $\text{IP} = n r$, and therefore $d = r \text{ Cos. } z + n r$, and

Figs. 3. 27. 61.

$$r = \frac{d}{n + \text{Cos. } z}; \;\ldots\ldots (1.)$$

This equation is common to all the sections. In the Ellipse and Hyperbola, put the eccentricity $\text{CF} = e$; the semitransverse axis $\text{CA} = a$; then because $1 : n : : e : a$, we have $n = \frac{a}{e}$, and

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$$r = \frac{e d}{a + e \text{ Cos. } z}; \;\ldots\ldots (2.)$$

This equation belongs to the Ellipse and Hyperbola.

Again, because when $z=0$, then $r = a - e$ in the ellipse, and $= e - a$ in the hyperbola; and as, in this case, $\text{Cos. } z = 1$, we have, in the former case, $e d = a^2 - e^2$; and in the latter $e d = e^2 - a^2$, therefore,

$$\left.\begin{array}{l} \text{In the Ellipse, } r = \dfrac{a^2 - e^2}{a + e \text{ Cos. } z}. \\ \text{In the Hyperbola, } r = \dfrac{e^2 - a^2}{a + e \text{ Cos. } z}. \end{array}\right\} \;\ldots\ldots (3.)$$

In the Parabola, put p for the parameter of the axis, then as in this case, $n=1$, we have

$$r = \frac{p}{2(1 + \text{Cos. } z)} \;\ldots\ldots (4.)$$

for the polar equation of the parabola.

Let us now suppose that the origin of the rectangular co-ordinates is at A, one of the vertices of the axis; put AI, the distance of the ordinate from the vertex, $= x$; ID the ordinate $= y$; and in the ellipse and hyperbola put BC the semiconjugate axis $= b$; then in the ellipse $a^2 : b^2 : : x(2a - x) : y^2$, (Sect. II. Prop. 16.); in the hyperbola $a^2 : b^2 : : x(2a + x) : y^2$, (Part III. Prop. 24.); therefore,

$$\left.\begin{array}{l} \text{In the Ellipse, } a^2 y^2 + b^2 x^2 - 2 a b^2 x = 0 \\ \text{In the Hyperbola, } a^2 y^2 - b^2 x^2 - 2 a b^2 x = 0 \\ \text{In the Parabola, } y^2 - p x = 0 \end{array}\right\} \;\ldots (5.)$$

In the ellipse and hyperbola, the centre may be taken as the origin of the co-ordinates, and then putting $\text{CI} = x'$, so that $x = a - x'$, we have

$$\left.\begin{array}{l} \text{In the Ellipse, } a^2 y^2 + b^2 x'^2 - a^2 b^2 = 0 \\ \text{In the Hyperbola, } a^2 y^2 - b^2 x'^2 + a^2 b^2 = 0 \end{array}\right\} \;\ldots (6.)$$

Since it appears that the rectangular co-ordinates of a conic *section* are in every case the variable quantities of an indeterminate equation of the second degree, it follows that every conic section is a line of the *second order*: The converse is also true, namely, that every line of the second order is a conic section, as we shall now demonstrate.

The equation to a line of the second order, in its most general form, is

$$\text{A} y^2 + \text{B} x y + \text{C} x^2 + \text{D} y + \text{E} x + \text{F} = 0,$$

where x and y denote co-ordinates to two axes, which are perpendicular to one another, (as explained in the theory of Curve Lines), and A, B, C, D, E, and F, are given quantities. By resolving this equation in respect of y, and putting $p = \text{B}^2 - 4\,\text{AC}$, $q = 2\,(\text{BD} - 2\,\text{AE})$, $r = \text{D}^2 - 4\,\text{AF}$, we find

$$y = -\frac{\text{B}x + \text{D}}{2\,\text{A}} \pm \frac{1}{2\text{A}} \sqrt{(p x^2 + q x + r)};$$

now that the equation may represent a real curve, the expression under the radical must be positive to all values of x within certain limits. If p be positive, we may suppose x to have such a value that $p x^2$ shall exceed the amount of the other terms, and every greater value of x will have the same property; so that in this case, the expression may always be positive. When p is negative, let the expression be put under this form,

$$\frac{1}{4p}\left\{(2 p x + q)^2 + 4 p r - q^2\right\}:$$

Then, in this case, to the values of x within certain limits, $(2 p x + q)^2 + 4 p r - q^2$ must also be negative, so that when multiplied by $\frac{1}{4p}$, the product may be positive, and consequently, changing the signs,

$$q^2 - 4 p r - (2 p x + q)^2,$$

must be positive; now the last term will always be negative, and it may evidently become as small as we please; therefore the whole expression may be rendered positive, provided that q^2-4pr or $4(BD-2AE)^2-4(B^2-4AC)(D^2-4AF)$ is a positive quantity. This expression when developed, and the common numerical multiplier rejected, gives us

$$A(AE^2+CD^2+FB^2-BDE-4AFC)$$

which, in the case of P or B^2-4AC being negative, must be a positive quantity, and this condition must be satisfied, otherwise the equation

$$Ay^2+Bxy+Cx^2+Dy+Ex+F=0$$

cannot represent a real curve.

Let the co-ordinates to any assumed point in the curve be a and b, so that

$$Ab^2+Bab+Ca^2+Db+Ea+F=0,$$

and let the origin of the co-ordinates be transferred to that point, by making

$$x=a+x',\ y=b+y';$$

x' and y' being new co-ordinates parallel to the former. Then we have

$$\left.\begin{array}{l} Ay'^2+Bx'y'+Cx'^2+(2Ab+Ba+D)y' \\ \quad +(2Ca+Bb+E)x' \end{array}\right\}=0$$

or, for greater simplicity, putting

$$2Ab+Ba+D=D',\ 2Ca+Bb+E=E',$$
$$Ay'^2+Bx'y'+Cx'^2+D'y'+E'x'=0.$$

Let us now change the direction of the co-ordinates x', y' about the new origin, at the same time keeping them at right angles to one another. This is done (see the article CURVES) by assuming

$$x'=x''\,\mathrm{Cos.}\,\alpha-y''\,\mathrm{Sin.}\,\alpha,\ y'=x''\,\mathrm{Sin.}\,\alpha+y''\,\mathrm{Cos.}\,\alpha,$$

x'' and y'' being new co-ordinates. By substituting these values of x' and y' we have

$$\left.\begin{array}{l} (A\,\mathrm{Cos.}^2\alpha-B\,\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha+C\,\mathrm{Sin.}^2\alpha)\,y''^2 \\ +(A\,\mathrm{Sin.}^2\alpha+B\,\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha+C\,\mathrm{Cos.}^2\alpha)\,x''^2 \\ +\left\{\begin{array}{l}2A\,\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha+B(\mathrm{Cos.}^2\alpha- \\ \quad \mathrm{Sin.}^2\alpha)-2C\,\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha\end{array}\right\}x''y'' \\ +(D'\mathrm{Cos.}\alpha-E'\mathrm{Sin.}\alpha)y''+(D'\mathrm{Sin.}\alpha+E'\mathrm{Cos.}\alpha)x'' \end{array}\right\}=0.$$

As the angle α is arbitrary, it may be taken such, that the term $x''y''$ may disappear; this will be the case if it satisfy the equation

$$\left.\begin{array}{l} 2A\,\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha+B(\mathrm{Cos.}^2\alpha-\mathrm{Sin.}^2\alpha) \\ \quad -2C\,\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha \end{array}\right\}=0.$$

But we have (ARITHMETIC OF SINES, Tables F. G.)
$\mathrm{Sin.}\,2\alpha=2\,\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha$, $\mathrm{Cos.}\,2\alpha=\mathrm{Cos.}^2\alpha-\mathrm{Sin.}^2\alpha$; therefore the equation which determines α may be put under this form

$$(A-C)\,\mathrm{Sin.}\,2\alpha+B\,\mathrm{Cos.}\,2\alpha=0,$$

which gives us

$$\mathrm{Tan.}\,2\alpha=-\frac{B}{A-C}.$$

The angle 2α will always be real, seeing that its tangent is real; thus the foregoing transformation and reduction are always possible. To introduce it into the equation, it must be observed that we have in general

$$\mathrm{Cos.}^2\alpha=\frac{1+\mathrm{Cos.}\,2\alpha}{2},\ \mathrm{Sin.}^2\alpha=\frac{1-\mathrm{Cos.}\,2\alpha}{2},$$

and by substituting these values and that of $\mathrm{Sin.}\,\alpha\,\mathrm{Cos.}\,\alpha$, we find the following expression equal to 0, viz.

$$\left\{A+C-B\,\mathrm{Sin.}\,2\alpha+(A-C)\,\mathrm{Cos.}\,2\alpha\right\}y''^2$$
$$+\left\{A+C+B\,\mathrm{Sin.}\,2\alpha-(A-C)\,\mathrm{Cos.}\,2\alpha\right\}x''^2$$
$$+2(D'\mathrm{Cos.}\,\alpha-E'\mathrm{Sin.}\,\alpha)\,y''+2(D'\mathrm{Sin.}\,\alpha+E'\mathrm{Cos.}\,\alpha)\,x''.$$

But from the value found for $\mathrm{Tan.}\,\alpha$, we get

$$\mathrm{Sin.}\,2\alpha=\frac{\mathrm{Tan.}\,2\alpha}{\surd(1+\mathrm{Tan.}^2 2\alpha)}=\frac{-B}{\surd\left\{B^2+(A-C)^2\right\}},$$

$$\mathrm{Cos.}\,2\alpha=\frac{1}{\surd(1+\mathrm{Tan.}^2 2\alpha)}=\frac{A-C}{\surd\left\{B^2+(A-C)^2\right\}};$$

if the co-efficients of y''^2 and x''^2 be represented by M and N, we shall find, by substituting these values of $\mathrm{Sin.}\,2\alpha$, and $\mathrm{Cos.}\,2\alpha$.

$$M=A+C+\surd\left\{B^2+(A-C)^2\right\},$$
$$N=A+C-\surd\left\{B^2+(A-C)^2\right\},$$

and the equation becomes

$$My''^2+Nx''^2+2(D'\,\mathrm{Cos.}\,\alpha-E'\,\mathrm{Sin.}\,\alpha)\,y''$$
$$+2(D'\,\mathrm{Sin.}\,\alpha+E'\,\mathrm{Cos.}\,\alpha)\,x''=0.$$

The co-efficients M and N are always real quantities, because $\mathrm{Tan.}\,2\alpha$ is a real quantity; but besides, M may be taken always positive, for that this may be the case, it is only necessary to dispose the terms of the equation so that A may be positive, which may always be done by changing the signs of the terms: And A being positive, if C is also positive, M will be entirely composed of positive quantities; but if C is negative, and equal to $-C$, the radical part which becomes then

$$\surd\left\{B^2+(A+C)^2\right\}$$

is greater than the rational part, which is then $A-C$: We shall therefore suppose M to be a positive quantity; as to N, it will be positive in some cases, and negative in others; and, in one case, it will be $=0$; for since $N=A+C-\surd\left\{B^2+(A-C)^2\right\}$; if $(A+C)^2 > B^2+(A-C)^2$, that is, if $4AC > B^2$, then N is positive. On the other hand, if $4AC < B^2$, then N is evidently negative; and if $4AC=B^2$, then in this case $N=0$; so that the equation may be expressed thus,

$$My''^2\pm Nx''^2+2(D'\,\mathrm{Cos.}\,\alpha-E'\,\mathrm{Sin.}\,\alpha)\,y''$$
$$+2(D'\,\mathrm{Sin.}\,\alpha+E'\,\mathrm{Cos.}\,\alpha)\,x''=0.$$

As this equation yet contains the quantities D', E', which are composed of the arbitrary co-ordinates a, b, we may make any other assumption that is consistent with the indetermination of x'' and y''. Let us therefore assume

$$2(D'\,\mathrm{Cos.}\,\alpha-E'\,\mathrm{Sin.}\,\alpha)=0;$$

by this, y'' vanishes from the equation; so that, if to abridge, we put

$$2(D'\,\mathrm{Sin.}\,\alpha+E'\,\mathrm{Cos.}\,\alpha)=P,$$

we have simply

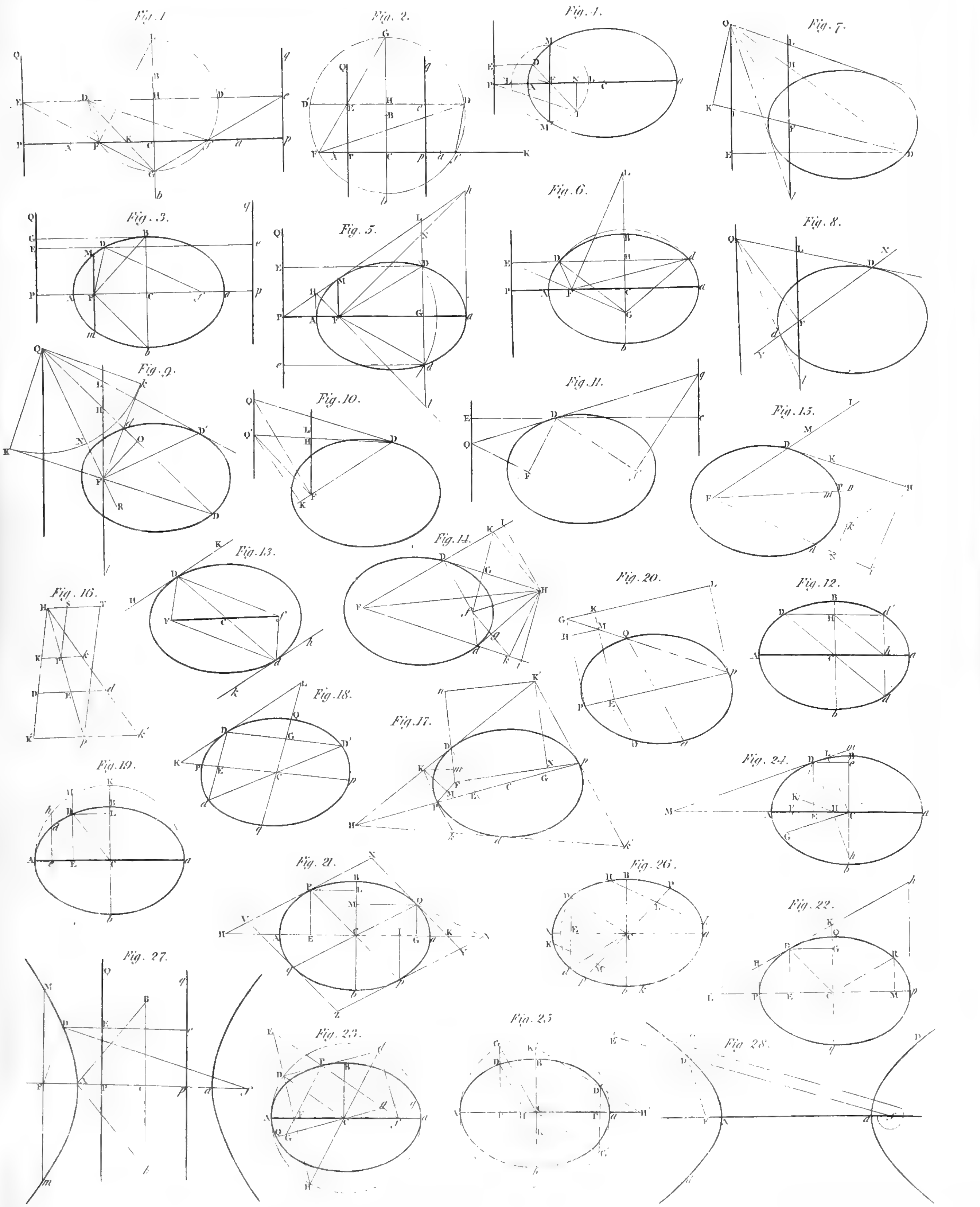
$$My''^2\pm Nx''^2+Px''=0$$

which evidently belongs to an ellipse if N is positive, or to an hyperbola if N be negative; or, lastly, to a parabola if $N=0$, the origin of the co-ordinates being manifestly in each case the extremity of the axis.

The co-ordinates a, b, at first taken as arbitrary, may now be determined from the assumptions which have been made; for by multiplying the equation $2(D'\,\mathrm{Cos.}\,\alpha-E'\,\mathrm{Sin.}\,\alpha)=0$ by $\mathrm{Sin.}\,\alpha$, it becomes

CONIC SECTIONS.

PLATE CCVII.



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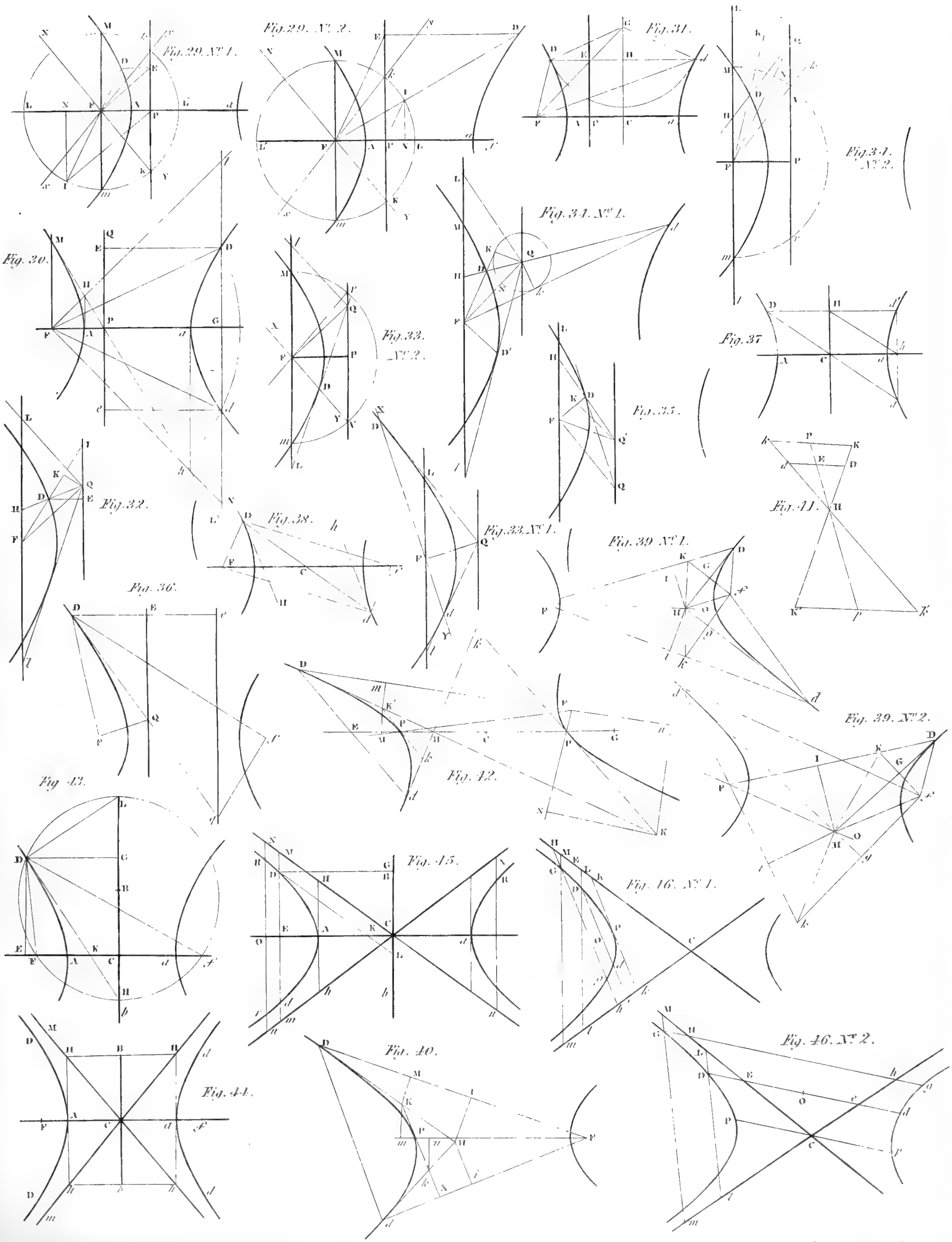

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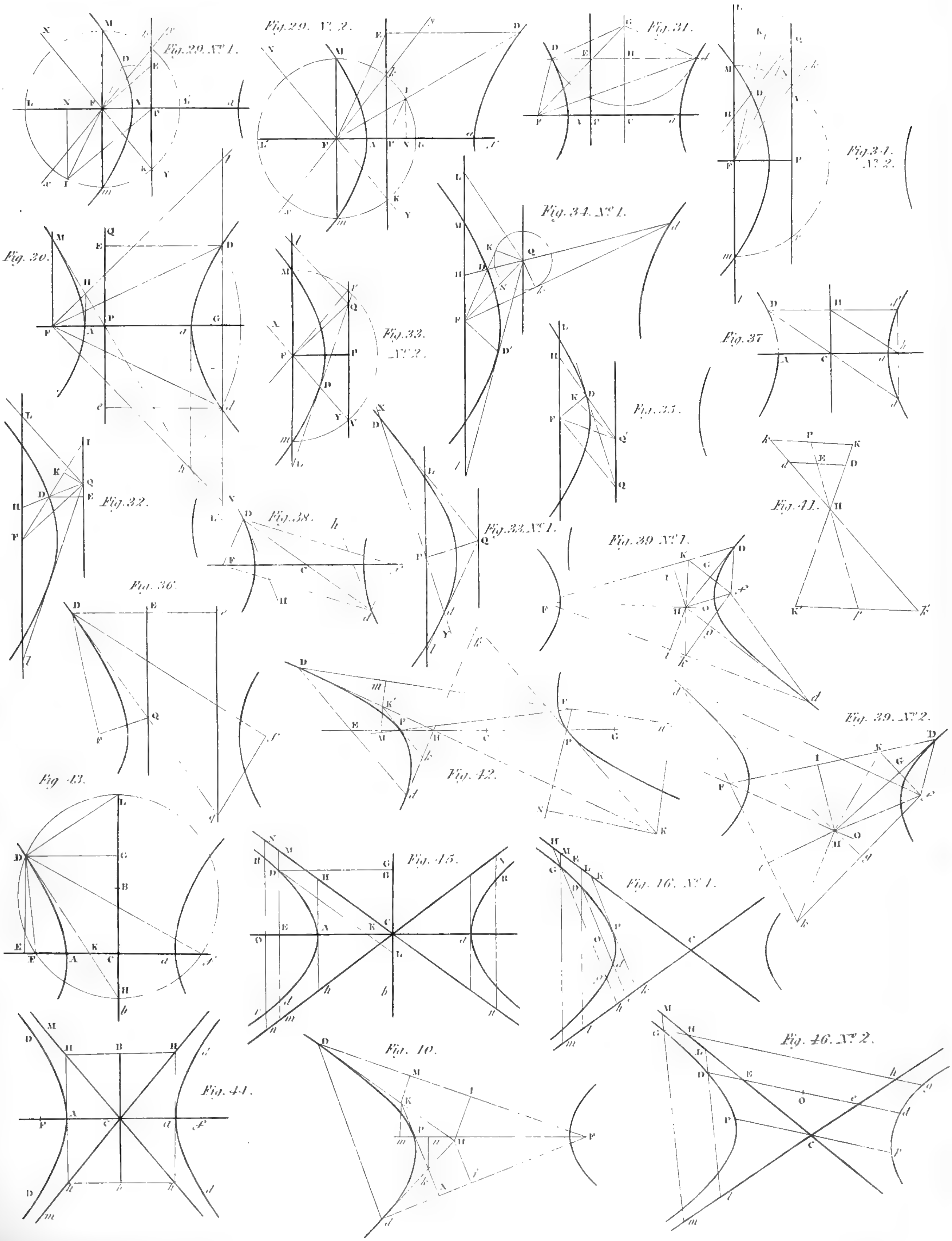

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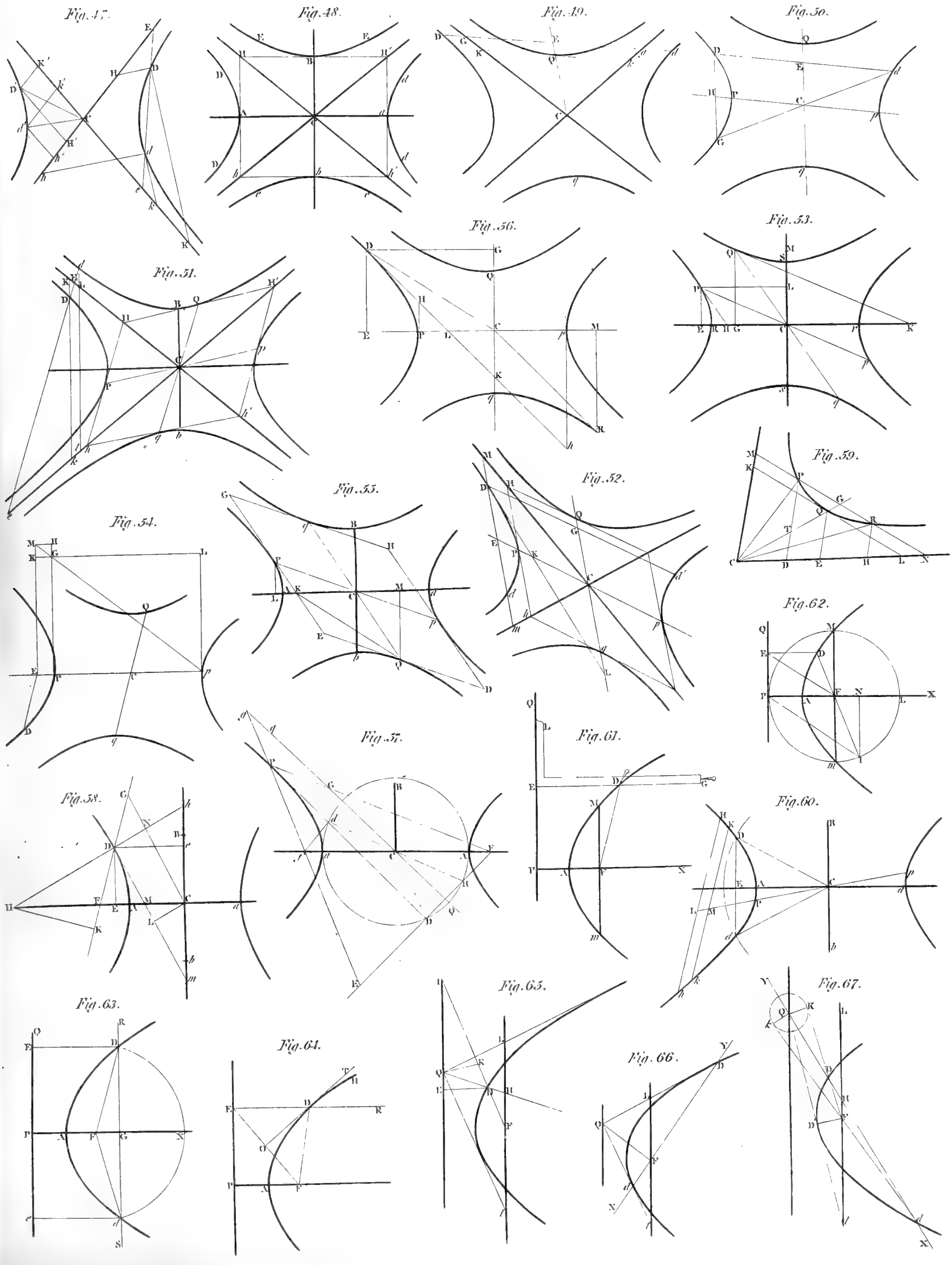

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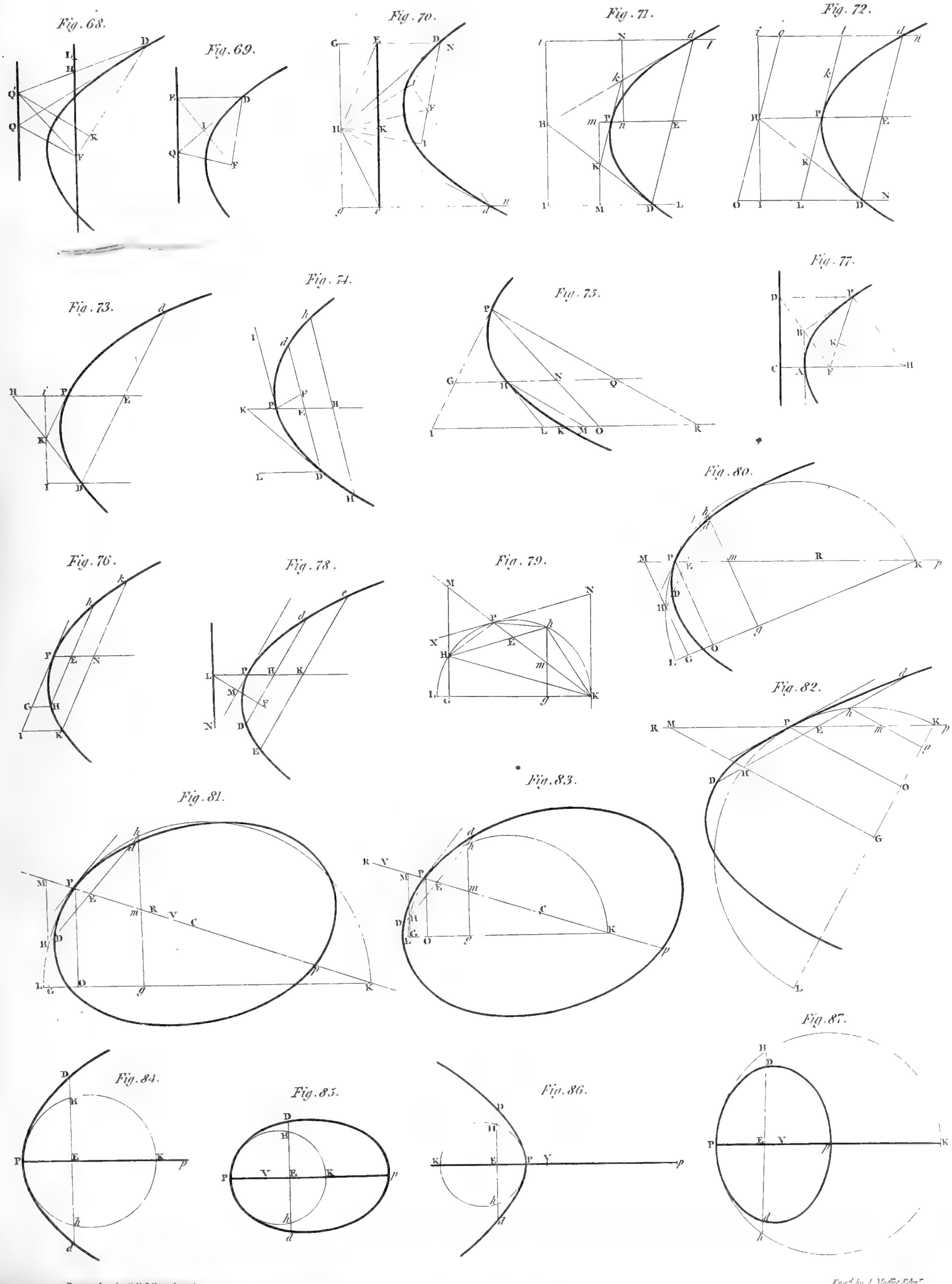

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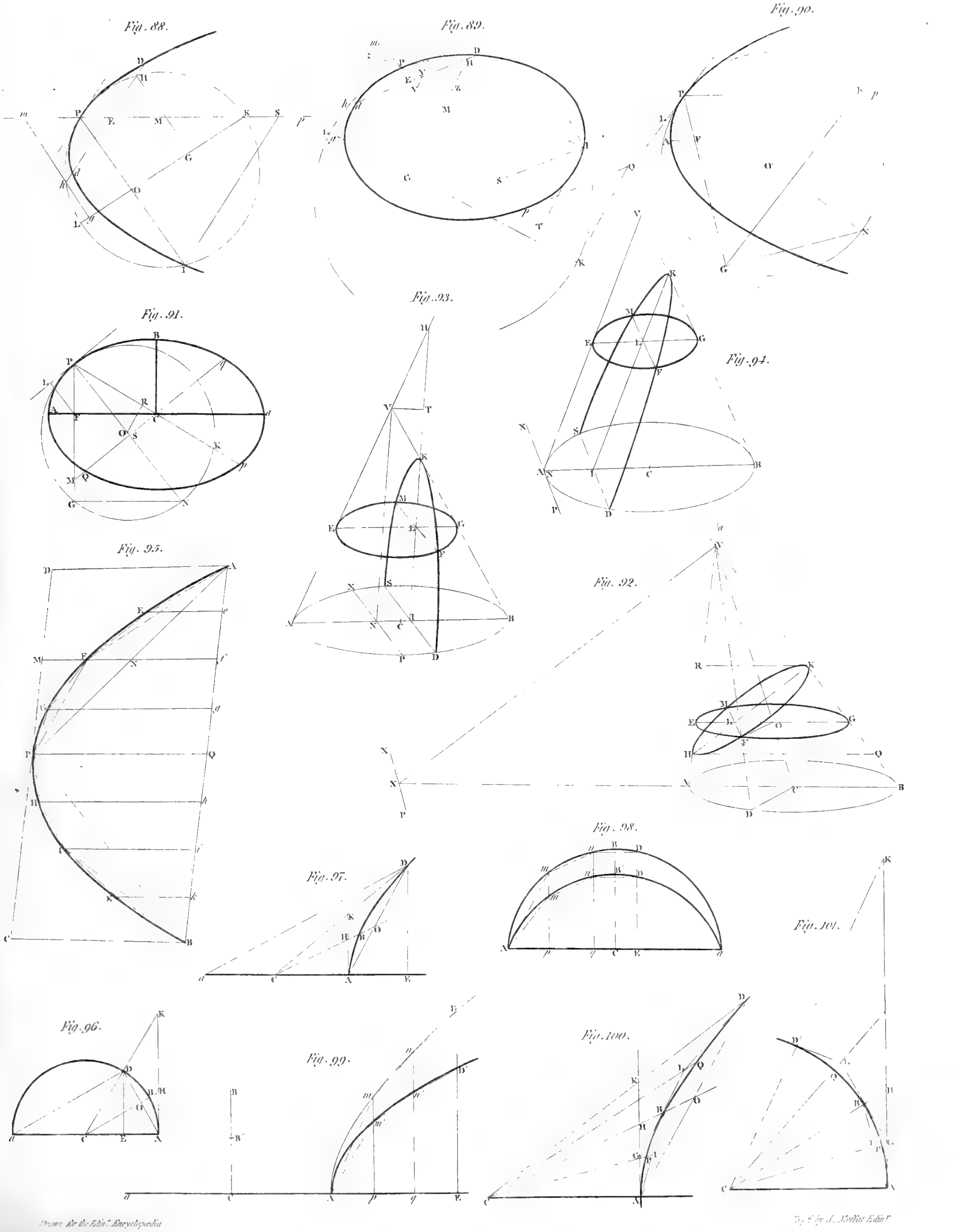
Fig. 88.
Fig. 89.
Fig. 90.
Fig. 91.
Fig. 92.
Fig. 93.
Fig. 94.
Fig. 95.
Fig. 96.
Fig. 97.
Fig. 98.
Fig. 99.
Fig. 100.
Fig. 101.

Equations of the Conic Sections.

$$2 D' \text{Sin.}\, \alpha \,\text{Cos.}\, \alpha - 2 E' \text{Sin.}^2 \alpha = 0,$$

that is,

$$D' \text{Sin.}\, 2\alpha - E'(1 - \text{Cos.}\, 2\alpha) = 0;$$

this expression, by putting for Sin. 2α and Cos. 2α their values, gives us

$$BD' - E' \left\{ A - C - \sqrt{B^2 + (A-C)^2} \right\} = 0;$$

and this equation combined with the equation

$$A b^2 + B a b + C a^2 + D b + E a + F = 0$$

serves to determine the values of a and b. (ξ)

Coniston, Conjugation.

CONISTON. See LANCASHIRE.

CONJUGATION (from the Lat. *conjugare*, "to yoke together"), literally means *a yoking or pairing together;* whence, among the old anatomists, it was applied to nerves proceeding together from the brain, and serving the same operation, being used to denote what we commonly express by the term *pair of nerves.* This sense of the word, however, is now in a great measure obsolete; and the term conjugation is seldom employed, except in grammar.

Conjugation, in grammar, has sometimes been used to signify the orderly inflexion of verbs in all their different moods, tenses, and persons; and, undoubtedly, the term might, in just conformity to the original sense, be so applied; but, in fact, it is rarely employed in this extended meaning. It is now most generally restricted to denote "the mode of forming, in any particular language, the principal moods and tenses, or the radical parts of the verb, from which the various inflexions of the several moods and tenses originate, and by which their form is regulated."

The number of conjugations, or modes of forming the parts of the verbs, varies in different languages; in some there is but one, in others several. The origin of these different conjugations subsisting in the same language, probably was this: the inflexions of the verb were at first formed by uniting, or amalgamating, as it were, with the theme or radical part, certain pronouns, nouns, or particles. Experience (the great arbiter of language) soon indicated that certain of these themes coalesced more readily, or perhaps more smoothly, with the united words, either when certain vowels were interjected, or when the terminating syllables were lengthened, contracted, or otherwise modified. From convenience and custom, therefore, particular modifications in particular classes of verbs came to be generally adopted; and variations consequently taking place in the mode of forming the principal inflexions, these were distinguished by grammarians by the title of *conjugations.*

The number of conjugations, we have said, varies in different languages. This naturally arose from the different structure of the several languages. In Saxon, German, and many others, there is but one conjugation; in English, also, there is properly only one. Some English grammarians have indeed attempted to make *three,* founded on the peculiar formation of the past participle, as terminating in *ed* (or its contraction *t*), *ght,* and *en;* but as, by this scheme, the number of verbs of the first conjugation would, beyond all proportion, exceed those of both the others; and as, in fact, the peculiar formation of the participle in the second and third may easily be traced to the first, only admitting a small variation for the sake of euphony; the best English grammarians have concurred in reckoning only one conjugation, holding the other forms as only irregular deviations from the first. In Latin there are four conjugations, distinguished by the termination of the infinitive mood in *are, ēre, ĕre,* and *ire.* In some of the modern languages derived immediately from the

Conjugation ‖ Connecticut.

Latin, a similar variety only blending the long and short *ere,* occurs. Thus the Italian has three conjugations, in *are, ere, ire;* the Spanish has also three, in *ar, er,* and *ir;* the French varying a little from these, has four, in *er, ir, oir,* and *re.* In Greek, the older grammarians made no less than *thirteen* conjugations; six, called *Boryton's,* in ω, because the last syllable was marked with a grave accent; four, called *circumflex,* in ω, because admitting a contraction, and then marked with a circumflex accent; and four in μι. Dr Busby reduced these thirteen conjugations to four; but his distribution was very imperfect, classing similar forms under different conjugations, and different forms under the same. Messrs de Port Royal at last, with great propriety, reduced the whole to *two* verbs, terminating in the present of the indicative in ω and in μι, the former by far the most numerous, comprehending all the Barytone and circumflex conjugations of the old grammarians, the latter (probably merely the more ancient form of the verb occasionally retained in a few, though disused in the greater number) containing comparatively few verbs, and admitting four subdivisions according to the differences of the penult vowel. This arrangement possessing the advantages of superior simplicity and perspicuity, has long been universally adopted in Scotland, though it appears, by the Westminster and Eton grammars, that it is not yet generally received among the Greek scholars in England. The Hebrew grammarians, by improperly giving the names of *conjugations* to those forms of the verb which, in all other languages, would be termed *voices* or *moods;* hence they have formed no less than seven conjugations; the first five technically marked by the names, 1. *kal,* the *active* voice of the verb; 2. *niphal,* the *passive;* 3. *hiphil,* denoting the *operating power;* 4. its converse, or the *being operated upon;* 5. *reflected action,* nearly similar to the middle voice in Greek; and, in addition to these five, the Masoretic doctors, by the refinement of their points, have added other two: 6. *pihal,* or the performing a work *diligently;* and, 7. its passive *puhal;* the being *diligently performed.* These are, by the Hebrew grammarians, termed *conjugations,* using the term in a sense quite different from that in which it is employed in any other language. In Hebrew, there is, in fact, but one conjugation; the modification which it undergoes may constitute voices and moods, but ought not to be designated as different *conjugations.* (δ)

CONIUM, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 164.

CONJUNCTIONS. See GRAMMAR.

CONNARUS, a genus of plants of the class Monadelphia, and order Decandria. See BOTANY, p. 267.

CONNAUGHT is the name of the western province of Ireland, which contains the counties of GALWAY, LEITRIM, MAYO, ROSCOMMON, and SLIGO. See these articles, for a Statistical Account of the Province.

CONNECTICUT, one of the United States of North America, comprehended within that part of the continent formerly called New England, and denominated by the ancient natives *Quennehticut,* is situated between

Connecticut. 41° and 42° 2′ north latitude, and between 71° 20′ and 73° 15′ west longitude. Its greatest breadth is about 72 miles, and its length 100 miles. It is bounded towards the north by Massachusets, on the east by Rhode Island; on the south by the sound which separates it from Long Island; and on the west by the state of New York.

Divisions. This state contains about 4674 square miles, equal to about 2,640,000 acres. It is divided into eight counties, viz. Fairfield, of which the chief towns are Fairfield and Danbury; New Haven, with a capital of the same name; Middlesex, the chief towns of which are Middlesex and Haddam; New London, of which the principal towns are New London and Norwich; and Litchfield, Hartford, Tolland, and Windham, each of which divisions respectively has a capital of the same name. Of these counties, the four former extend along the Sound from north to east; the others in the same direction, on the border of the state of Massachusets. They are divided into townships, which again are subdivided into parishes. The number of these townships is about 100, in each of which are contained two or more parishes, which are severally supplied with one or more places of public worship, and likewise school-houses at convenient distances. At New Haven there is a college.

Population. In 1756, the population of this state amounted to 130,611 persons; in 1774, to 197,856; in 1782, to 202,877 whites, and 6273 Indians and negroes; in 1790, to 237,496, exclusive of 2764 slaves; in 1800, to 251,002, of whom 121,113 were free white males, 123,528 free white females, 5300 free persons, except Indians, not taxed, and 951 slaves; and in 1810, to 261,727. The original stock, from which have sprung all the present occupiers of Connecticut, is said to have consisted of 3000 persons, chiefly from England, who settled here about the years 1635 and 1636.

Climate. Though exposed to the extremes of heat and cold, and to sudden changes of temperature, this country is very healthful. The north-west winds which prevail during the winter are keen, owing to the great body of snow which lies concealed from the influence of the sun in the immense north and north-west forests; but the serenity of the sky during the same season, makes amends in some degree for this severity of the weather. In the maritime towns, the weather is particularly variable, changing as the wind blows from the sea or land; in the inland country it is less so.

The territory of the state of Connecticut is generally broken land, made up of mountains, hills, and vallies. The soil is rich and fertile, though intermixed with portions that are comparatively thin and barren; and the whole is well watered. The principal productions are Indian corn, rye, wheat in many parts of the state, oats and barley, and of late some buck-wheat; flax in large quantities, some hemp, potatoes, pumpkins, turnips, pease, beans, &c. The principal object of the culture of the state consists, however, in its meadows, which enable the farmers to feed great numbers of neat cattle, horses, and other stock, with such advantage, that a given extent of good meadow land in Connecticut yields a return double of that derived from land laid under corn in the best districts of New York. Many farmers in the eastern part of the state have lately found their advantage in raising mules, which are carried to the West India islands.

The state of Connecticut is generally laid out in small farms, from 50 to 300 and 400 acres each, which are for the most part well cultivated. The country is intersected with numerous roads, in any of which, even in the most unsettled parts of the state, a traveller can seldom proceed more than two or three miles without finding a house or cottage, and a farm under such improvements as to afford the necessaries for the support of a family.

Rivers. The principal rivers of Connecticut are one of the same name, the Housatonick, and the Thames.

The Connecticut, which is the principal river in the eastern part of the United States, rises in the high lands which separate the states of Vermont and New Hampshire from Lower Canada. It has been surveyed about 25 miles beyond the 45° of latitude, to the head spring of its northern branch; from which, to its mouth, it flows upwards of 300 miles, through a well inhabited country. It fertilizes the lands through which it runs, but its navigation is much interrupted by falls. Some of these occur at Enfield in this state, at which place, to render the river navigable for boats, a company has been incorporated, and a sum of money raised by lottery. The principal stream which it receives within the Connecticut state, is the Farmington, which falls into it from the west at Windsor. At Hartford it meets the tide, whence it passes on in a winding course, till it falls into Long Island Sound, between Saybrook and Lyme. At its mouth there is a bar of sand, on which, however, at full tide, there is a depth of water of 10 feet. Above Middleton there are some shoals which, even at high tide, when the increase in the depth of the water may be about eight inches, are not more than six feet deep. About three miles from this city, the river is contracted by two mountains to the space of about 40 rods; but even so much farther up the stream as at 130 miles from its mouth, the breadth is from 80 to 100 rods, and commonly the banks are low, spreading into fine extensive meadows, which in the spring floods are covered with water. Notwithstanding the bar just mentioned, this river is navigable as far as Hartford, 50 miles distant from its mouth, for vessels of some burden, and the produce of the country for 200 miles above it is brought thither in flat-bottomed boats, which were so light as to be portable in carts. An important improvement was effected in 1795, by the completion of the locks and canals round the falls at South Hadley. Sturgeon, salmon, and shad are caught in abundance in this river, likewise a variety of small fish, such as pike, carp, and perch. In 1789, there were employed from or upon it three brigs of 180 tons each in the European trade, and about 60 sail from 60 to 150 tons in the West India trade, besides a few fishermen, and 40 or 50 coasting vessels; and a considerable increase has since taken place in these numbers.

Of the Housatonick river, one branch rises in Lanesborough, the other in Windsor, both in Massachussets. After passing a number of towns, it empties itself into the Sound, between Stratford and Milford, being navigable for 12 miles as far as to Derby, but with an obstruction in the way of large vessels, arising from a bar of shells at its mouth. Between Salisbury and Canaan there is a cataract in its course, where its whole water, which is here 150 yards wide, falls about 60 feet perpendicularly in a perfectly white sheet.

The Thames falls into Long Island Sound at New London, being navigable for 14 miles from its mouth to Norwich landing. At this point it divides into two branches, Norwich, or Little River, on the west, and on the east Shetucket. About a mile from the mouth of the former of these, there is a remarkable and very romantic cataract. The whole of the river having first pitched, in an entire sheet, over a rock 10 or 12 feet in perpendicular height, which extends quite across, is

Connecticut. Rivers.

channel, and then swiftly tumbling, foaming with the most violent agitation, for the space of about 15 or 20 rods, over the narrow, crooked, and gradually descending rocky bed, that next receives it, falls at length into a broad bason. The smoothness of the water above the descent, the regularity and beauty of the perpendicular fall, the tremendous roughness of the other, the curious excavations produced in the rock by the long continued impulses of the water, with the craggy towering cliffs which, on each side of the river, on one of them particularly, impend, the whole presenting to the view a scene highly striking and majestic. On this river, which in each of its branches is fed by numberless brooks from every part of the adjacent country, there occur some of the finest mill-seats in New England, or perhaps in the world.

Besides the Naugatuck and the Farmington rivers, which severally empty themselves into the Housatonick and the Connecticut, there are also the East or North-Haven river, the Mill river, and West river, with a number of other small rivers west of the Housatonick, none of which are of any great consideration. Of those last mentioned, the Byram may be noticed, as forming a part of the boundary between this state and New York.

Harbours. The whole of the sea-coast of Connecticut is indented with harbours, many of which are safe and commodious. The two principal ones are at New London and New Haven. The former opens to the south; the distance from the light-house, which stands at it mouth, to the town, being about three miles, its breadth three-fourths of a mile, and in some places more. The depth of water in the harbour is from five to six fathoms, with a clear bottom, tough ooze, and for a mile above the town, secure and commodious stations for large ships. The harbour of New Haven is greatly inferior to this. It is a bay which sets up northerly from the Sound about four miles, with good anchoring ground; but no where any considerable depth of water. Its entrance is about half a mile wide.

Mines. Mines of different kinds have been found in this state, but in general they have not been wrought to any considerable extent. On the banks of the Connecticut, two miles from Middleton, there is one of lead, which while wrought during the war, was found productive, but attended with great expence. Copper mines have been discovered and opened in several parts of the state, but having proved unprofitable, have been much neglected. The same thing may be said of the zinc mines. Iron mines are numerous and productive. Steel ore has been found in the mountains between Woodbury and New Milford. There occur here also talcs of various kinds; white, brown, and chocolate-coloured crystals, with several other fossils and metals. At Stafford there is a medicinal spring, which is said to be a sovereign remedy for scorbutic, cutaneous, and other disorders. There has also been observed a spring at Guildford, of the water of which it is mentioned as a peculiarity, that when taken from the fountain it will evaporate, even though put into a bottle, and tightly corked.

Manufactures. The linens and woollens of Connecticut are for the most part manufactured by individuals; the farmers of this state, with their families, being usually clothed in plain, decent, homespun cloth, which, though of a coarser kind, is commonly of a stronger texture, and much more durable than those imported from France and Great Britain. There are, however, other cloths also produced here, which are fine and handsome. In Hartford, a woollen manufacture has been established, and is protected by the legislature, which promises to be successful. At New Haven, there are flourishing linen and button manufactories. Large orchards of mulberry trees are raised in this state; and silk worms have been reared so successfully, as to promise not only a supply of silk to the inhabitants, but even to afford a surplus for exportation. In East Hartford, there are glass-works, a snuff and powder mill, iron-works, and a slitting-mill. Iron-works are established also at Salisbury, Norwich, and other parts of the state, while a sufficient supply for the whole of it of hollow ware and other ironmongery may be obtained from the furnace which has been erected at Stafford. Paper is manufactured at Norwich, Hartford, New Haven, and in Litchfield county. Nails of every size are made in almost every town and village in Connecticut, of which considerable quantities can be exported to the neighbouring states, and at a better rate than they can be had from Europe. Hats of the best kinds, candles, leather, shoes and boots, are prepared in this state, besides wooden dishes, and other wooden wares, which are made in vast quantities in Suffield and other places, and sold in almost every part of the eastern states. From the seed of the sun-flower, there is here expressed an oil, which is as mild as sweet-oil, and is equally agreeable with sallads and as a medicine: it may also be used in paints, varnishes, and ointments. Oil mills, of a new and very ingenious construction have been erected in several parts, for the expression of this oil; while, from the quantity of it that may be drawn from any given extent of ground, and the price which it yields in the market, the business of its preparation is found to be very profitable for those engaged in it. At Stratford there is farther established a duck manufactory.

Trade. The trade of Connecticut is chiefly with the West India islands, the exports to which consist of horses, mules, oxen, oak-staves, hoops, pine-boards, oak planks, beans, Indian corn, fish, beef, pork, &c. This traffic is carried on in vessels from 60 to 140 tons burden. A great number of coasting vessels is also employed in carrying the produce of this to the other states. The articles supplied to those different states are different. To Rhode Island, Massachussets, and New Hampshire, are furnished pork, wheat, corn, and rye; to North and South Carolina, and Georgia, butter, cheese, salted beef, cider, apples, potatoes, and hay, in return for which are obtained chiefly rice, indigo, and money. A good deal of the whole trade with these states is conducted through the medium of the markets of New York; the chief of the articles thus conveyed being pot and pearl ashes, flax-seed, beef, pork, cheese, and butter.

A considerable proportion of the produce of the eastern parts of the state, is disposed of at Boston, Providence, and Norwich. The value of the whole exported produce and commodities from the state of Connecticut before the year 1774, was then estimated at about L.200,000 annually. In the year ending September 30. 1791, the amount of foreign exports was 710,340 dollars, independently of articles to a great value carried to different parts of the United States. In 1792, it was 749,925 dollars; in 1793, 770,239 dollars; in 1794, 806,746 dollars; and in 1804, 1,516,110, of which 1,486,882 are to be included under the head of domestic, and 29,228 of foreign trade. This state employs in the two branches of its business, the foreign and the coasting, upwards of 32,897 tons of shipping.

Vessels

In 1774, the number of its vessels had been 180; their tonnage 10,317; seafaring men 1162, besides upwards of 20 sail of coasting vessels, which employed about 90 seamen. Various causes concurred rather to diminish for a time than to increase these amounts; the more favourable state of which, at periods more recent, is at once an indication and a consequence of the generally increasing prosperity of the state.

Towns.

There is in Connecticut a great number of very pleasant towns, both maritime and inland. It contains five cities, incorporated with extensive jurisdiction in civil causes. The capitals of the state are Hartford and Newhaven. At the former of which the General Assembly is holden annually in May, at the latter in October. Hartford, situated, as has been said at the head of navigation, on the west side of Connecticut river, has a very fine back country, enters largely into the manufacturing business, and occupying an advantageous position for trade, is a rich flourishing commercial town. Newhaven, lying round the head of the bay of the same name, covers part of a large plain, which is circumscribed on three sides by high hills or mountains, and on the east and west is bounded by two small rivers. The situation is in a high degree at once pleasant and healthful, and the state of the town prosperous. It carries on a considerable trade with New York and the West India islands. New London stands on the west side of the river Thames, near its entrance into the sound, in lat. 41° 25′, both in respect of its situation generally, and of the goodness of its harbour, enjoying considerable facilities for the prosecution of trade. Norwich, which is situated at the upper part of the same river, avails itself of the natural advantages which it possesses, as being placed at the head of navigation with a rich and extensive back country, and with the command of many convenient sites for mills and water machines of all kinds, being, as in such circumstances was reasonably to have been expected, a considerable manufacturing and trading town. The executive courts of law are held alternately here and at New London. Middleton, which is pleasantly situated on the western bank of Connecticut river, 15 miles south of Hartford, carries on, like that town, a large and increasing trade. Of other towns more or less considerable in this state, there are, on the banks of the river just mentioned, Saybrook, Haddam, Weathersfield, Windsor, Suffield, Enfield, East Windsor, East Hartford, Glastonbury, East Haddam, and Syme. Farmington, Litchfield, Milford, Stratford, Fairfield, and Guildford, are also all rather respectable and very pleasant towns.

Religion.

There are very few religious sects in this state, the bulk of the people being Congregationalists. There are, however, some Episcopalians and Baptists, and at Newhaven there is a society of Sandemanians. The Episcopalian churches are respectable, and are under the superintendence of a bishop. The education of all ranks of people is attended to here with as much assiduity, perhaps, as in any part of the world. Almost every town in the state is divided into districts, each of which has its public school, that is kept in it a greater or less part of every year. Somewhat more than a third of the monies arising from a tax on the polls and rateable estate of the inhabitants, is appropriated to the support of education in the several towns. In every county town throughout the state, it is directed by the law that there shall be a grammar school. Academies have also been established at several places within its bounds, some of which are in a very flourishing condition. Yale college, now in Newhaven, is an eminent seminary of learning; it was founded in the year 1700. The first charter of incorporation in its favour was granted to eleven ministers, under the denomination of trustees, in 1701. The powers of the trustees were enlarged by the additional charter 1723. And by that of 1745 they were incorporated by the name of the President and Fellows of Yale College, Newhaven. The corporation are empowered to hold estates, continue their succession, make academic laws, elect and constitute all officers of instruction and government usual in universities, and confer all learned degrees. The ordinary executive government is in the hands of the president and tutors. The course of education in this university comprehends the three learned languages, together with so much of the sciences as can be communicated in four years. Great attention is paid also to oratory and the belles lettres. The public library belonging to the university consists of about 2500 volumes, and the philosophical apparatus contains at least the principal machines necessary for exhibiting most of the experiments usually introduced in courses of experimental philosophy and of astronomy. In the college museum, to which additions are constantly making, there are several natural curiosities. Proportionable to the attention given towards furnishing the means, is the thirst for learning which prevails among all ranks of people in this community. More of the young men in Connecticut, relatively to their numbers, receive a public education than in any of the other states. Some have thought, and perhaps not without reason, that the fondness for academic and collegiate education, is here too great, tending to draw off more than enough from the primarily useful occupations. It may be supposed also to be a consequence of this sedulous direction of the youthful mind to learning, that there is found in the national character so much of a certain gravity and seriousness of deportment, accompanied with a degree of shyness and reserve, that cannot fail to appear to strangers in rather a forbidding and disagreeable light. Be that as it may, it is yet to be understood that it is only on the occasion of a first introduction that this temper materially shews itself. On better acquaintance, the people of this state are found to be abundantly familiar and inquisitive, and their hospitality is highly exemplary and laudable. In respect to external appearance and manners, the men of the state of Connecticut are commonly tall, stout, and robust; the women are fair, genteel, and handsome; they are moreover strictly virtuous, and often well informed. The prevailing amusements here are dancing, fishing, hunting, skaiting, and riding in sleighs * on the ice. In winter, the sleigh is also much in use for travelling. At other seasons, the common mode of travelling, both for men and women, is on horseback. The luxury of wheel carriages is, at the same time, by no means altogether unknown.

Education, &c.

Constitution.

The constitution of Connecticut is founded on its charter, which was granted by Charles II. in 1662, and on a law of the state. By these the supreme legislative authority is vested in a governor, deputy-governor,

* The sleigh is a vehicle which hangs on four posts, standing on two steel sliders or large skates. It is drawn by two horses, and can carry six persons.

Connecticut. Constitution.

twelve assistants or counsellors, and the representatives of the people, styled the General Assembly. The governor, deputy-governor, and assistants, are annually chosen by the freemen in the month of May. The representatives, of whom the number is not to exceed two from each town, and who generally amount from 160 to 180, are chosen by the same body twice in the year, to attend the two annual sessions held on the second Tuesdays of May and of October. The general assembly is divided into two branches, distinguished as the upper and lower houses: the former is composed of the governor, deputy-governor, and assistants: the latter of the representatives of the people. No law can pass without the concurrence of both these houses. The assembly, in its collective capacity, has power to erect judicatories for trying causes civil and criminal, as well as to establish laws for settling the forms and ceremonies of government. The judges of the superior court there appointed, hold their offices during the pleasure of the same assembly. The judges of the county courts and justices are appointed annually. Sheriffs are nominated by the governor and council without limitation of time. The governor is captain-general of the militia; the deputy-governor lieutenant-general: all other military offices are appointed by the assembly, and commissioned by the governor. The freemen in general are eligible to any office of government: their qualifications are maturity in years, quiet and peaceable behaviour, a civil conversation, and freehold estate to the value of 40s. per annum, or £40 personal estate in the list, certified by the select men of the town: it is necessary also that they should take the oath of fidelity to the state.

The people of Connecticut have had the good sense to avoid a change of constitution, notwithstanding the declaration of independence. The revolution which so essentially affected the government of most of the colonies, produced here no very perceptible effect. While under the jurisdiction of Great Britain, this state elected its own governors and all subordinate civil officers, and made its own laws in the same manner, and with as little controul as it still continues to do. Connecticut has ever been a republic, and exhibits perhaps one of the best examples of a perfect and happy government of that kind. While other states accordingly more monarchical in their government and manners, have been laid under the necessity of introducing, in both respects, important and difficult alterations, Connecticut has proceeded uninterruptedly in her old track, and thus has escaped the convulsions by which they have been so much torn and agitated.

Courts, &c.

The common law of England, so far as it is applicable here, is considered also as the common law of this state. The reports of adjudication in the courts of King's Bench, Common Pleas, and Chancery, are accordingly read in its courts as authorities; which are, however, not deemed by the judges to be binding, further than as they are founded on solid reasons directly affecting their state, or sanctioned by concurrent adjudications of their own courts. Pardons and reprieves can be granted only by the General Assembly, likewise commissions of bankruptcy, or protection to the persons and estates of unfortunate debtors. The supreme court of errors, consisting of the deputy-governor and twelve assistants, determine writs of error brought on judgments of the superior court. This latter, which is a circuit court, and has two stated annual sessions in each county, consists of five judges, who have authority in all criminal cases extending to life, limb, or banishment, and other high crimes and misdemeanors, also to grant divorces, and to hear and determine all civil actions brought by appeal from the county courts or the court of probate, and to correct the errors of all inferior courts. Of the courts of probate, the peculiar province is the probate of wills, granting administration on intestate estates, ordinary distribution of them, and appointing guardians for minors. The county courts, which are held respectively by one judge and four justices, have jurisdiction in all criminal cases arising within their several counties, where the punishment does not extend to life, limb, or banishment. They have original jurisdiction also in all civil actions which exceed the cognizance of a justice. Of the justices, a number of whom is appointed annually in each town by the General Assembly, the authority extends to the hearing and determining of civil actions, where the demand does not exceed four pounds, likewise to small offences, punishable within prescribed and very narrow limits, by fine, whipping, or sitting in the stocks. Writs are issued through the state, by assistants and judges, as by the justices through their respective counties. In these must be contained the substance of the complaints or declarations which give occasion for them; and if neither of the parties show good reason for delay, the causes are heard and determined the same term to which the writs are returnable. The plaintiff has always his election to attach or to summon the defendant. There is here no attorney-general, but there is an attorney to the state for each county. Few of what are called the fictions of law are here known or put in practice. The county courts admit and qualify those who are to act as practitioners before them, who being so admitted, have the privilege, without farther qualification, of practising in any court of the state.

In this state the feudal system of descents has never been adopted. The whole real property of intestates is divided equally among the children, males and females, the eldest son, however, having a double portion; and it is provided, that all estates given in tail, must be given to some persons then in being, or to their immediate issue, or shall become fee-simple estates to the issue of the first donee in tail. The widow of an intestate is entitled to a third part of the personal estate for ever, and during her life to a third part of the houses and lands which belonged to him at the time of his death. With a view to the defraying of the public expences, all freeholders in the state are required by law to give in, at a particular season, lists of their polls and rateable property to persons appointed in the several towns to receive them. These being valued, are arranged in proper order, and forwarded to the general assembly. On their amount, taxes are levied at rates per pound proportioned to the extent of the sums proposed to be raised. The ordinary annual expences of government before the war, amounted to near £4000 sterling, exclusive of that which was appropriated to the support of schools. This amount has since been increased.

Territory.

The territory of Connecticut, at the time that the English first arrived thither, was possessed by the Pequot, the Mohegan, Podunk, and many other smaller tribes of Indians. The Pequots were numerous and warlike. Their country extended along the sea coast from Paukatuck to Connecticut river; and about the year 1630, their conquests, besides other territory, reached over a considerable portion of what is now comprehended under this state: the seat of the sovereign of the whole nation was Pequot. The Mohegans were numerous, and their territory extensive, containing most

Connecticut. of New London county, almost the whole county of Windham, and a part of the counties of Tolland and Hartford. The Podunks inhabited East Hartford, and the adjacent country. In 1774, there remained of the descendants of these ancient nations not more than 1363 persons, who lived chiefly at Mohegan, between Norwich and New London. The Indian population in this state has, since that period, still continued to be so rapidly on the decrease, that it has been concluded their whole number does not now exceed 400.

History, &c. The first grant of Connecticut was made by the Plymouth council to the Earl of Warwick in 1630, who, in the following year, assigned it to Lord Say and others. Some Indian traders settled at Windsor in 1633. The same year in which, a little before the arrival of the English, a few Dutch traders had settled at Hartford, and the remains of whose settlement are still visible on the bank of Connecticut river. In 1634, the English built the fort of Saybrook, and purchased from the Pequot Indians the lands on the banks of that river. The right of conquest gradually extended the possessions of the English, who established themselves at New Haven in 1638. This new colony at first formed a distinct body politic, which was not united to that of Connecticut till the year 1665. These rising colonies during that interval, present the disgusting picture of religious persecutions among men, whom every thing should have conspired to unite. The Quakers, who were the principal objects of it there as in Europe, owed to it their increase. The colony at length gained considerable enlargement. The Connecticut adventurers had, in 1644, purchased of Mr Fenwick, agent for Lord Say, and the others concerned, their right to the possession of it for £1600. Tracts of land continued to be procured from the Indians, and new towns were settled from Stamford to Stonington, as well as far back into the country. In 1661, all the lands connected with it, which had not previously been purchased by particular towns, were bought of the natives, and a public surrender made of them to the colony in the presence of the General Assembly. It was in the year subsequent to this, that it obtained from Charles II. the charter of its liberty and union. Ten years thereafter, its laws were formed into a uniform code, and on every individual was imposed the duty of making himself acquainted with them. A copy of this code, which was reprinted in a small volume in 1750, and of which Dr Douglas says that there can be none more natural, more equitable, more simple, or more concise, was to be purchased by every family at a stipulated price in silver, or for a determinate measure of some kind of grain; and the sort of knowledge which was thus to be obtained, being so generally and so anciently diffused in the colony, may, as has been remarked, have contributed its part towards forming amongst the people that litigiousness of disposition, by which even to this time they continue to be distinguished. The fondness, whether proceeding from this, or from some other cause, that is discernible among the people of Connecticut, for settling even their most trifling disputes according to law, while it paves the way for a sufficient employment to a numerous body of lawyers, necessarily gives but an unfavourable impression of their national character. The disposition, however, it is to be observed, is now by degrees subsiding, and what is hardly of less consequence for the advancement of internal peace and harmony, is the abatement which has also taken place in the rage that formerly prevailed here for theological disputation. It would have required perhaps a more particular observation than is often given to such matters, to have ascertained whether the earlier or the more recent character of this people in that latter respect has been materially dependent on any thing in the peculiar forms of their church government. It is of more consequence to remark, that these seem, upon the whole, and in general, to be sufficiently in unison with the republican nature of the civil establishment of the state. While, according to them, each congregation or church has its separate jurisdiction, claiming authority to choose its own minister, to exercise judgment, and to enjoy religious institutions within itself, they yet connect themselves in associations, to which is committed the power of licensing candidates for the ministry, of consulting for the general welfare, and of recommending, though not of enforcing, particular measures for the benefit of the churches. Of such associations there are eleven in the state, which are in like manner combined under one more general association. The number of churches altogether upon the congregational model is said to amount to about 200. Though the numbers attaching themselves to distinct religious sects in this state be not considerable, that is not the consequence of any impediment being placed in the way of such variety of profession, the principle that is acknowledged in this respect being in fact that of making the sole ground of exception, or exclusion against any particular tenets, that they are inconsistent with the peace of society. The public proceedings of this state are in general conducted with calmness and candour, and there seems to be every where enjoyed in it a competent share of political tranquillity. Its laws, before so well adapted to the condition and circumstances of a colonial government, have been yet farther and very judiciously simplified, in the revision to which they were subjected since the peace.

In the years 1675 and 1676, great distress and confusion were brought upon this colony, in consequence of the destructive inroads of the enraged savages, with different tribes of whom in the neighbourhood it was then engaged in war. In 1684, it very narrowly escaped the loss of its charter; but when it was intended that it should in this respect have been subjected to the same fate, which actually befel some of the other states in its vicinity, it owed its security to the artful conduct of one of the citizens, who, as the charter was on the point of being delivered up, buried it under an oak tree in Hartford, where, having remained till the danger was over, it was afterwards dug up and reassumed. At the close of the revolution, Connecticut ceded all her charter claims west of Pennsylvania to Congress, reserving only a tract of land as wide as the state, and 120 miles in length, bounded on the east by the western line of Pennsylvania, and north by lake Erie, and containing nearly four millions of acres. Congress accepted the cession, on which basis accordingly the title of Connecticut to the reserved lands is fully established. This state has been very happily distinguished, in having, almost from the period of its first establishment, had the benefit of a succession, uninterrupted or nearly so, of governors, eminent in a high degree at once for their religious character, and their political accomplishments. Population in 1811, 261,727. See Morse's *American Geography;* Thompson's *Alcedo*, vol. i.; and Peuchet *Dictionnaire de la Geogr. Commerçante.* (K)

CONOBŒA, or Conopea, a genus of plants of the class Didynamia, and order Angiospermia. See Botany, p. 250.

CONOCARPUS, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 155.

CONOID, is the name of a solid, formed by the revolution of a conic section about its axis. Thus, if the conic section is a parabola, the resulting solid is called a *parabolic conoid*, or *paraboloid*; if a hyperbola, a *hyperbolic conoid*, or *hyperboloid*; if an ellipse, an *elliptic conoid*, a *spheroid*, or an *ellipsoid*. (*w*)

CONON. See ATHENS, vol. iii. p. 32.

CONOPS. See ENTOMOLOGY.

CONOSPERMUM, a genus of plants of the class Tetrandria, and order Monogynia. See BOTANY, page 130; and Brown's *Prodromus Plant. Nov. Holl. et Ins. Van Diem.* p. 368.

CONOSTYLIS, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 196; and Brown's *Prodromus Plant. Nov. Holl.* &c. p. 300.

CONRAD I. II. III. IV. See GERMANY.

CONSANGUINITY. See MARRIAGE.

CONSCIENCE, is that principle, power, or faculty within us, which decides on the merit or demerit of our own actions, feelings, or affections. It has been called the *moral sense* by Lord Shaftesbury and Dr Hutcheson. This appellation has been objected to by some; but has been adopted and defended by Dr Reid, who says, "the testimony of our moral faculty, like that of the external senses, is the testimony of nature, and we have the same reason to rely upon it:" (*Active Powers*, p. 242.) He considers conscience as an original faculty of our nature, which decides clearly, authoritatively, and instantaneously, on every object that falls within its province. "As we rely," says he, "upon the clear and distinct testimony of our eyes, concerning the colours and figures of the bodies about us, we have the same reason to rely, with security, upon the clear and unbiassed testimony of our conscience, with regard to what we ought and ought not to do."

Without, in the slightest degree, questioning the utility and authoritative influence of conscience, we must be allowed to think, that Dr Reid is unfortunate in illustrating its power by the analogy of the external senses. With regard to the intimations received through the organs of sense, there can be no difference of opinion, and there can be no room for argument. They give us at once correct information, which reasoning can neither invalidate nor confirm. But it is surely impossible to say as much for the power of conscience, which sometimes gives the most opposite intimations with regard to the simplest moral facts, and which requires to be corrected by an accurate attention to the established order of nature, or to the known will of God, before we can rely with confidence on its decisions.

It does not appear, that conscience can with propriety be considered as a principle distinct from that which enables us to pronounce on the general merit or demerit of moral actions. This principle, or faculty, is attended with peculiar feelings, when we ourselves are the agents: we are then too deeply interested to view the matter as a mere subject of reasoning; and pleasure or pain are excited, with a degree of intensity proportioned to the importance which we always assign to our own interests and feelings. In the case of others, our approbation or disapprobation are generally qualified, sometimes suspended, by our ignorance of the motives by which they have been influenced; but, in our own case, the motives and the actions are both before us, and when they do not correspond, we feel the same disgust with ourselves that we would feel towards another, whose motives we knew to be vicious, whilst his actions are specious and plausible. But in our own case, the uneasy feeling is heightened in a tenfold degree, because self-contempt and disgust are brought into competition with the warmest self-love, and the strongest desire of self-approbation. We have then something of the feelings of a parent, who knows the worthlessness of the child he loves, and contemplates with horror the shame and infamy which might arise from exposure to the world.

Conscience, then, cannot be considered as any thing else than the general principle of moral approbation or disapprobation applied to our own feelings or conduct, acting with increased energy, from the knowledge which we have of our motives and actions, and from the deep interest which we take in whatever concerns ourselves; and we do not think that they have deserved well of morals or philosophy, who have attempted to deduce our notions of right and wrong from any *one* principle. Various powers both of the understanding and of the will, are concerned, in every moral conclusion; and even in those cases where we decide with instantaneous promptitude, the decision is the result of a long induction, rendered familiar, and almost imperceptible, by habit.

We conceive, however, that the Author of our nature has furnished us with infallible principles of judging concerning right and wrong, in giving us certain instincts and feelings, and in establishing a certain order and course of nature, to which these instincts and feelings are adapted. When we see any person acting in direct opposition to the principles and feelings common to human nature, or violating that order of things which God has evidently appointed, we are compelled to pronounce that he is acting wrong; and were all our feelings as simple as instincts, and our knowledge of the order and constitution of things complete, we would need no other rule of duty, but would be led, with infallible certainty, to that line of conduct most conducive to individual and public happiness. This, however, is far from being the case; our feelings are irregular and complex; the designs of providence are not always readily perceived; and a long induction of particulars is frequently necessary, before we can pronounce, with confidence, respecting the merit or demerit of certain actions. With regard to some, indeed, the light of nature can never lead us to a satisfactory conclusion. From this view of the subject, it is evident that a train of reasoning is either actually employed, or imperceptibly implied in every moral decision; and conscience seems to be nothing else than reasoning applied to morals, with a particular reference to our own interests and feelings.

In this view, it will appear that the common language on the subject is pretty correct, and that conscience may, with sufficient propriety, be called the voice of God, as it proclaims his will, after it has been ascertained by a reference to the constitution of our nature, to the economy of providence, or to the light of revelation.

Conscience often acquires a powerful mechanical influence from habit, and frequently inflicts great uneasiness when we deviate from customary though indifferent actions. But it derives its chief and most salutary influence from the consideration of our being continually in the presence of God, and accountable to him for all our thoughts, words, and actions. A conscience well-informed, and possessed of sensibility, is the best security for virtue, and the most awful avenger of wicked deeds; an ill-informed conscience, is the most powerful instrument of mischief; a squeamish and ticklish conscience, generally renders those who are under its influence contemptible and ridiculous.

——— Hic murus aheneus esto,
Nil conscire sibi, nulla pallescere culpa. (*g*)

CONSCIOUSNESS, denotes "the immediate knowledge which the mind has of its sensations and thoughts, and, in general, of all its present operations."

Such is the definition given by Mr Stewart in his *Outlines of Moral Philosophy*, and generally adopted by modern writers on pneumatology, who limit the word to the present operations of the mind, and find fault with Mr Locke, who talks of the consciousness of past feelings and actions. "Of all the present operations of the mind," says Mr Stewart, "consciousness is an inseparable concomitant."

There does not appear to be much reason for this restriction: for certainly consciousness is also an inseparable concomitant of all mental operations which are the objects of memory. The remembrance of past thoughts and sensations, if unaccompanied by consciousness, would be viewed in the same light as the recorded journal of another's sentiments and feelings; and we would consider ourselves as no more accountable for them than for those which we meet in the records of history. The memory retains past thoughts and sensations; consciousness stamps them as our unalienable property.

But is it certain that consciousness accompanies all the present operations of the mind? Does the mind never act, on any occasion, but when we are sensible of it? Would it not be more correct to say, that consciousness necessarily accompanies all the *sensible* operations of the mind, whether they relate to present or past thoughts or sensations? In fact, consciousness seems to be that peculiar quality which constitutes *animality*; which enables animals to perceive and feel, and distinguishes them from those beings which are destitute of life, and organization. Without it, we would have no evidence that the mind thinks at all, and we could have no perception of external objects.

The belief with which consciousness is attended, has been considered as the most irresistible of any; insomuch that this species of evidence has never been questioned: and yet, as Mr Stewart well observes, it rests on the same foundation with every other kind of belief to which we are determined by the constitution of our nature.

There seems to be no good reason for distinguishing the belief arising from consciousness, from the other kinds of belief which necessarily result from the constitution of our nature. Consciousness attends every species of belief, and every feeling of the mind; is in itself perfectly passive, merely reporting what is felt, and giving notice of the impressions received through the medium of the senses and the faculties.

"We cannot properly be said," says Mr Stewart, "to be conscious of our own existence; our knowledge of this fact being necessarily posterior, in the order of time, to the consciousness of those sensations by which it is suggested."

Now, with due deference to such great authority, we are inclined to think, that the consciousness of our sensations and the consciousness of our existence are simultaneous; that we cannot be conscious of feeling without being conscious of existence. The knowledge of our existence is surely not a matter of reasoning; it is forced upon us irresistibly; when we know we feel, we know we exist; and if any man is disposed to doubt his existence, we should think it very idle to attempt to convince him. Des Cartes removed his doubts on this important subject, by the famous maxim, *cogito ergo sum;* if he meant to say, that a thinking being necessarily exists, the argument is extremely absurd, as it assumes the thing to be proved: but if he meant to affirm that the knowledge of our sensations, and the knowledge of our existence, are simultaneous and identical, we conceive that he is perfectly right; and that the consciousness of thought and feeling, gives an instantaneous, irresistible evidence of existence.

Mr Locke conceived that we derived our notion of personal identity from consciousness alone; it is from consciousness and memory that we acquire this idea. See Logic and Metaphysics. (*g*)

CONSECRATION, is the act of solemnly devoting, or setting apart, certain persons, places, and things, to religious duties or purposes. This act, though it has frequently been accompanied with superstitious, absurd, and even impure rites, has its foundation in a principle of reverence for the Deity, and a conviction of the propriety of embodying that reverence in suitable expressions of outward devotion. Among every people, accordingly, however remote from each other, and however dissimilar in character or worship, the obligation of such acts has been felt and recognised. So strong, indeed, is this principle, and so universally does it operate, that, not to mention the Jews, who were divinely commanded to count their first born, whether of men or of cattle, and the first fruits of the earth, sacred to Jehovah; the Greeks, Romans, Egyptians, Persians, Hindoos, and all other heathen nations, have uniformly considered particular persons, animals, plants, rivers, mountains, groves, or caverns, &c. as naturally consecrated to the service or residence of particular deities. But besides this *natural* consecration, as it may not improperly be termed, the consecration of individual persons, places, and things, has formed an important part of worship under almost every form of religion, and has been attended with peculiar solemnities and ceremonies. To some of these we shall now shortly advert.

The consecration of Aaron and his sons to the priestly office, began with an ablution of water, by which they were ceremonially purified; they were then anointed with precious oil, compounded of various costly and fragrant spices; after which they were clothed in the sacerdotal robes. These were eight; four common to all the priests, and four peculiar to the high-priest. The former were the linen drawers, the coat, the girdle, and the turban, all of which, especially in the case of the high-priest, were richly embroidered and adorned with jewels. The latter wore the robe of a blue colour, splendidly fringed, and ornamented with golden bells; the ephod, or short cloak, on the shoulders, fastened by two buttons of onyx or emerald, having the names of the twelve tribes engraven on them; the girdle, on which were the "breast-plate of judgment," studded with four rows of jewels set in gold, and the Urim and Thummim, with the names of the 12 patriarchs graven on it also; and, lastly, the holy crown of gold, having this inscription, "Holiness unto the Lord." The ceremony was concluded by the sacrifice of several animals, some of the blood of which was sprinkled on the tip of the right ear, the thumb of the right hand, and the great toe of the right foot of the priests who were consecrated, certain parts of the sacrifices being at the same time put into their hands. From this last circumstance, the consecration of the ordinary priests was said to be "by *filling the hand*," which, from any thing that appears to the contrary, was the only solemnity observed at their admission into office. It is equally uncertain whether all these ceremonies were repeated at the instalment of every new high priest, or whether he was merely invested with the pontifical habit.

Of the manner in which the consecration of priests among the ancient Greeks was conducted, we have no precise information; but Manilius and Prudentius have described the ceremonies with which the inauguration of particular pontiffs among the Romans was accompanied. "According to the latter," says the learned author of *Indian Antiquities*, "the Taurobolium, a ceremony in which the high-priest of Cybele was consecrated, might be called a baptism of blood. In this dreadful and sanguinary ceremony, the high-priest, about to be inaugurated, was introduced into a dark excavated apartment, adorned with a long silken robe and a crown of gold. Above this apartment was a floor perforated in a thousand places with holes like a sieve, through which the blood of a sacred bull, slaughtered for the purpose, descended in a copious torrent on the inclosed priest, who received the purifying stream on every part of his dress, rejoicing to bathe with the bloody shower his hands, his cheeks, and even to bedew his lips and his tongue with it. When all the blood had run from the throat of the immolated bull, the carcase of the victim was removed, and the priest issued forth from the cavity a spectacle ghastly and horrible, his head and vestments being covered with blood, and clotted drops of it adhering to his venerable beard. As soon as he appeared before the assembled multitude, the air was rent with congratulatory shouts;" and he was saluted by their acclamations with the title of *Pontifex*. *Maurice*, vol. ii. p. 196.

By the Greeks, all dead persons were thought to be under the jurisdiction of the infernal deities; and, therefore, no man could resign his life till some of his hairs were cut out, as an offering by which he was consecrated to them, and especially to Proserpine. They were also consecrated by having peculiar honours conferred on their memory, such as celebrating the anniversary of their death, erecting monuments, statues or altars to them, according to the degree of virtue which they were supposed to have attained, or the eminent public services which they had performed. Some were even raised to the level of the gods; in which case their consecration was called θεοποιΐα; and the sacrifical worship given them θυσια, the same term that was used with respect to the greatest of their deities. This latter custom prevailed also among the Romans. Thus Romulus was worshipped as a God, under the name of Quirinus. And hence, afterwards, the solemn consecration (αποθεωσις) of the emperors by a decree of the senate, when they were said to be ranked in the number of the gods; priests, and temples, and altars, on which sacrifices were offered, being assigned to them. The vestal virgins, after having been chosen by lot, or selected according to the pleasure of the high-priest, were consecrated, first by cutting off and burying their hair, and then arraying them in long white robes bordered with purple, and decorating their heads with fillets and ribbons.

In the ancient Christian church, to the canonical consecration, or *ordination* of a *Bishop*, it was required that at least three bishops should be present, two of whom held the book of the Gospels over his head, and whilst one pronounced the blessing, or consecration prayer, the others solemnly laid their hands on his head. He was then conducted by his brethren to his chair or throne, and having placed him in it, they saluted him with a holy kiss. *Presbyters* were consecrated kneeling at the altar, with prayer, imposition of hands, and consignation, or the sign of the cross on the head. In the consecration of *deacons*, the whole service consisted of a prayer by the officiating minister, that God would endow them with suitable gifts, and enable them faithfully to discharge the duties of their office. But imposition of hands, as well as prayer, seems to have been observed in the consecration of *deaconesses*, so early as the time of Cyprian and Tertullian; and consequently long before the establishment of convents, we read of virgins dedicating themselves to the service of religion, by vowing to lead a single life. If they kept their vow till they reached the age of 40, before which their consecration was not reputed valid, they expressed to the bishop their wish of being consecrated, and having gone to the church, and publicly professed their resolution in the presence of the congregation, the bishop, or presbyter at the altar, put on them a particular kind of veil, and a mitre of purple and gold, by which they might be distinguished from all other females. In later ages, when superstition increased, other ceremonies were added, and the *taking of the veil* was the signal of at least the external relinquishment of every secular concern, and of subjection to a life of rigid seclusion from society.

Under the head of the consecration of persons, we may notice, lastly, that of the Pope. This name was given to the ceremony observed at the instalment of every new pontiff, and was conducted in the following manner, till the pontificate of Gregory X. when the present usage of the conclave of cardinals was introduced. Three days after the funeral of the former pope, the cardinals assembled in the Lateran church, and having invoked the Holy Spirit, and celebrated mass, proceeded to elect a successor to him. The election being made, the first cardinal deacon invested the Pope elect in his pontifical habits, and announced the new name which he chose to assume. He was then conducted to the altar, where he prostrated himself, while the cardinals sung the *Te Deum*. They next seated him in a marble chair behind the altar, where the cardinals, bishops, and others were admitted to kiss his feet, and to receive the kiss of peace. After being led to another chair, called the *stercorary*, and seated in it, the choir sung Psal. cxiii. 7, 8, adding this clause, "and that he may possess the throne of his glory;" on the conclusion of which the chamberlain put into his hands three derniers, which he threw to the people, saying, *silver and gold I have none for my pleasure, but what I have I give you*. He then went into the portico, where he was hailed with shouts of acclamation, and his election declared. After this he walked in procession to the basilic of St Sylvester, and there being seated in a chair of porphyry, he received from the prior of that church, the pontifical ferula and keys; carrying which, he again placed himself in another chair, and then returned these insignia of power to the priors, who girt him with a girdle of red silk, and gave him a silken purse of the same colour, in which were twelve precious stones, and a small piece of musk. In this chair he received and returned the salutations of the ministers of the palace, and cast among the people three several times some silver coin, saying, "He hath dispersed, he hath given to the poor, his righteousness endureth for ever." On the following Sunday, attended by all the orders of the sacred palace, and the principal people of the city, he went to the church of the Vatican, and was there solemnly consecrated by the Bishop of Ostia, to whom this function specially belonged. Lastly, he received the papal pall, and was addressed by the Archdeacon in these words, "Receive the pall, which is the plenitude of the pontifical office, to the honour of Almighty God, of the most happy Virgin his mother, of the blessed apostles St Peter and St Paul, and of the Holy Roman church."

With regard to the consecration of *places* among the Jews, we refer the reader to the account which Scripture gives of the solemnities which took place at the erection of the tabernacle in the wilderness, and the temple of Solomon. Among the Greeks and Romans, all religious edifices, whether temples or tombs, were consecrated with the offering up of prayers and sacrifices by the officiating ministers of religion. This was one of the peculiar duties of the Roman augurs; by whom also, sepulchres or burying places, both private and public, and the walls and gates of cities, were solemnly consecrated; but when a temple was dedicated by the magistrates, the presence of the Pontifex Maximus was requisite. At the consecration of temples, altars, &c. to the celestial gods, the priests bathed their whole body, were clothed in white, made libations by heaving the liquor out of the cup, and prayed with the palms of their hands raised towards heaven. The animals which they sacrificed to them were also white, and in immolating them, their neck was bent upwards, the knife was applied from above, and the blood was sprinkled on the altar or received into cups. But when consecrations were made to the infernal deities, the priests were dressed in black; they only sprinkled their body with water, threw the cup into the fire, and prayed with their hands turned downwards, at the same time beating the ground with their feet. In this case the victims were likewise required to be black; and were killed with their faces bent to the earth, the knife being applied from below, and the blood allowed to pour into the surrounding trench or ditch. By the Greeks, sepulchres and graves were consecrated, by being adorned with parsley, amaranthus, lilies, roses, myrtle, &c. woven into garlands, which were suspended on the monuments, or laid on the turf. The grave stones were frequently also perfumed with sweet ointments; and sometimes altars were erected near the sepulchres, on which black and barren heifers or sheep were sacrificed, and libations of honey, wine, milk, water, &c. poured forth.

It is uncertain when the practice of consecrating *Christian* churches was first introduced; but we find it universally prevalent so early as the reign of Constantine. At that period, whenever the building of a church was finished, to render the consecration or dedication of it more solemn and impressive, commonly a synod of the neighbouring or provincial clergy assembled in the newly erected edifice; when the solemnity usually commenced with a panegyrical oration or sermon, consisting chiefly of praise and thanksgiving to God, and sometimes expatiating on the character or memory of the founder, or the splendor and utility of the fabric. They then proceeded to the "mystical service, or the offering of the unbloody sacrifice to God," praying for the peace of the world, the prosperity of the church, and a blessing on the emperor and his family. A similar practice, at least the ceremony of offering up prayers, still prevails in most Christian countries, either at laying the foundation, or at the opening for public worship, of new churches. Under the episcopal form of worship also, church yards or burying places, are, in general, consecrated by reading particular prayers and other religious rites, before they can be canonically used for Christian interment. In England, churches in particular, have always been consecrated with peculiar ceremonies; the precise form of which, however, has always been left to the discretion of the presiding bishop. Yet for introducing a number of Popish rites, at the consecration of certain churches in London, Archbishop Laud was, in 1644, subjected to general indignation; and his conduct on these occasions, even made one ground of his prosecution by the House of Commons.

Various *animals* were consecrated both by the Greeks and the Romans. Among the former, it was common to devote whole herds of cattle, and several kinds of fowls, especially geese and peacocks, to their gods; by giving them their liberty, and strictly prohibiting them from being touched or molested. Nor were fishes overlooked; they sometimes even put necklaces on them, and then turned them loose into the rivers or ponds. In like manner, the ancient Romans consecrated all the cattle that were produced from the first of March to the end of April, a ceremony which was called *ver sacrum;* and mention is made by Suetonius, of the consecration of a great number of horses by Cæsar when he passed by the Rubicon; and by Pliny, of the consecration of a dolphin which belonged to Octavius Anicius.

The consecration of images, statues, and trees among the Greeks, was the same with that of altars. For the poor sort of the people, all that was required was an oblation of sodden pulse, which a woman, dressed in a garment of divers colours, brought in a pot on her head, and offered in sacrifice to the particular deity to which they were dedicated. The more opulent sometimes took a new vessel with two ears, on each of which they bound a chaplet of white wool, and another of yellow on the forepart of it; they then covered the vessel, and poured out before it a libation called *ambrosia,* which was a mixture of water, honey, and all sorts of fruits. But the most usual method of consecrating statues, &c. was by crowning them with flowers, anointing them with oil, in which the act of consecration chiefly consisted; and then offering prayers and libations to them. The water also used at these sacrifices was rendered sacred, by plunging into it a torch taken from the altar. And the armour and spoils taken in war were consecrated, by suspending a part of them in the temples, or on monuments and statues, or by burning a portion of them on the altars. *Magical* consecrations were not unfrequent among the Romans; it being customary for the emperors to offer sacrifices, repeat charms, and place statues in certain situations, with the view of warding off danger from the empire.

The Roman Catholics, besides an immense multitude of superstitious ceremonies employed at the consecration of almost every thing used in their religious service, such as bells, candles, water, oil, images, crosses, rosaries, &c. apply the term *consecration* in a most peculiar sense to the benediction of the elements in the eucharist, by which they are conceived to be instantaneously converted into the real body and blood of Christ. The same term is given to this part of religious worship even among Protestants, the prayer which is offered up by the officiating pastor, before the bread and wine are distributed to the communicants, being usually called the consecration-prayer.

See Jenning's *Jewish Antiquities;* Potter's *Antiq. of Greece;* Adam's *Roman Antiquities;* L'Enfant's *Hist. Council of Constance;* Spelman, *de non temerandis Ecclesiis;* and Bingham's *Origines Ecclesiasticæ.* (*d*)

Consecutive, Consonance.

CONSECUTIVE CHORDS, in Music, imply a succession or repetition of the same consonance in similar motion. Dr Holder has shewn, that this succession of the same chord, in musical passages, where the parts move the same way, either up or down, and not occasioned by the different parts of the composition moving different ways, or one up and the other down, is cloying and disagreeable, and therefore forbidden in concords, by the rules of harmony or counterpoint, and that consecutive discords are not less offensive, so that the rule against consecutive intervals is in reality general; and he remarks, that the many writers on composition who have limited their prohibition to consecutive fifths, octaves, unisons, and fourths, have not duly considered, that it is only the mingling of *major* and *minor* thirds, sixths, &c. in the scale, that allows any of these to be used consecutively, any more than the perfect concords, as they improperly call them, as above-mentioned; and, that consecutive major thirds, or minor thirds, &c. without the mixture of the two, would as strikingly offend, as those against which the prohibition has hitherto been most levelled. When, instead of an immediate succession of the same chord, an alternate, or any other similar succession of the same chords in the scale, occur in ascending or descending diatonically,—the same is called a *sequence*. (ϱ)

CONSONANCE, in Music, is a term for the union or blending of two sounds, produced at the same time, and includes every possible musical interval.

Consonances naturally divide themselves into three important classes, viz. 1*st*, *Perfect* CONCORDS, (see that article,) or such as produce an agreeable and pleasing effect on the ear. 2*d*, *Imperfect*, or tempered, CONCORDS, which never can differ much from some one of the perfect concords, and have rather a pleasing effect, each distinguished by the peculiar characters of the perfect concord to which it belongs, but alloyed or disfigured by an accompanying and disagreeable phenomenon, called BEATS, which are sorts of *wa, wa, ya, ya,* &c. noises, (see that article,) increasing in quickness, as the tempered concord is more and more imperfect, either in excess or defect, until at length these separate and distinct noises, becoming too quick to be separately distinguished, they blend into a faint discordant note, (whenever the beats exceed about $12\frac{1}{2}$ in a second of time,) which again blends with, or forms a consonance, in a certain degree, with the imperfect concord itself; and where the imperfection is a little farther increased, the same degenerates into a most disagreeable flutter and dissonance, as the experiment that we shall presently describe, from the late Dr Robison, will shew, if carefully repeated. And, 3*d*, DISCORDS, or intervals, that have a grating or disagreeable jarring effect on the ear, or a fluttering roughness in some cases, as will further appear below.

The difficulties under which the science of harmonics still labours, for want of any general and characteristic distinction of consonances, into *concords* and *discords*, has been pretty fully shewn in the former of these articles; and we cannot but recommend a careful repetition of Dr Robison's experiment below, with still more perfect and delicately contrived apparatus, as the most likely means, from the contemplation of the effects of all the possible consonances that thence arise, of leading to an extension of our knowledge of the characteristic properties of each of the above three classes of consonances.

Dr Robison's experiment, alluded to above, is to be thus conducted, on a SONOMETER, provided with two strings, and a resined wheel, that can be steadily turned by the foot, or by an assistant, for the purpose of causing both these strings to sound, clearly and smoothly, for any length of time; the moveable bridge to one of these strings should slide with great truth and steadiness, by means of a screw or a rack and pinion, and not strain or force the string out of its position, or sensibly alter its tension in any part. These two strings, being of the same wire and length, when the sliding bridge is nearly, but not quite, drawn back, are to be tuned, by turning their pegs to a perfect unison. Then, *first*, in order to try the effect of flattening this unison, draw the moveable bridge a little further back, and the smooth uniform consonance of the two strings will be at first accompanied by slow *beats*; these, by a little further withdrawing of the bridge, or lengthening of the string, will increase in quickness and disagreeable effect, until, by a further and farther withdrawing of the bridge, they will become too quick to be distinctly counted; shortly after which, they will seem to form a new very deep, though not very loud, sound, varying in its pitch, and becoming more acute as the bridge is farther drawn back; and a rattling flutter, the combined effect of this new sound and the two strings, will succeed; and after that a disagreeable jar.

The bridge may now be returned to its first position, or where a smooth uni-consonance (I) is heard, without any beats that are sensible, however slow; then, the moveable bridge being slowly and gradually moved forwards, at first a slow and by degrees a quicker beating, (like those before described, but beating *sharp*, or increasing the contrary way,) will be heard, and increase in rapidity, as the bridge is advanced, until they can no longer be counted; and at length these will degenerate into a violent rattling flutter, which will soon after, as the bridge advances, become a disagreeable jarring noise. Still advancing the bridge, vile discordant noises will result from the sound of the two strings, until the variable string has been shortened almost $\frac{1}{10}$th of the length of the fixed string, or where a little more than $\frac{9}{10}$ths of the string continues to sound; when a very rapid angry flutter will commence, and which will become rather less rapid and offensive to the ear, as the point $\frac{9}{10}$ths is approached (II′), and the same will then increase, as the bridge advances, until the discordant jar again prevails, and which will continue until $\frac{8}{9}$ths of the string is approached, when a nearly similar flutter will commence and decrease, and again increase as this point (II) is passed by the bridge; the jar beginning again and accompanying the motion of the bridge, until arrived within some distance of $\frac{5}{6}$ths of the fixed string's length, when a flutter and rapid beats will succeed, decreasing in frequency, until at $\frac{5}{6}$ths, or when the minor third (3rd) is sounded, they will cease entirely, and a concord will result, rather agreeable than otherwise, but strongly marked by a mournful melancholy in the expression.

This last concord being sufficiently noticed, the bridge is again to be advanced by slow degrees, and the beatings will commence again, and increase in quickness, and at length flutter; and the same grating dissonance as before will succeed: this will continue until near the point marked $\frac{4}{5}$ths, when the flutter and beatings will again commence, having a peevish fretful expression as they decrease, owing to the advance of the bridge, to the exact point marking the major third (III); when all beating having ceased, the peculiarly enliven-ing and gay character of this concord will be experienced by the hearer; and who will be able to notice the angry and waspish effect of the succeeding beats as the string is shortened, but which will soon give place to a fluttering and jar as before.

When little more than $\frac{3}{4}$ths of the string's length continues to sound, the fluttering and rapid beats will again be heard, and the beats decreasing, will entirely cease at the point marking the minor fourth (4th,) which will be noticed as a soft and agreeable concord. To this, first slow and then rapid beats will succeed, and rapid flutterings, and a jarring noise, nearly as before, until near $\frac{32}{45}$ths of the string, when the flutter will commence again, and decrease, until they are the slowest, and capable of being counted, at the place of the major fourth (IV); after which, as the bridge advanced, they increased again in quickness, and an indistinct and jarring noise succeeds, which will soon again become a flutter that will decrease in quickness, and about one-third more of them in a second will be capable of being counted; then at the major fourth, when the minor fifth (5th) is reached, at $\frac{45}{64}$ths of the string; these flutters will then increase again, and be succeeded by a jarring noise as before.

The flutterings will be heard to commence again as the bridge advances, and pass into a gentle and not unpleasant undulation, and beats that will cease at $\frac{2}{3}$ds of the string, or the major fifth (V), with all the cheering sweetness that characterizes this concord, or union of the sound of the two strings, which will now be found to blend so perfectly, that neither of them can be separately distinguished; after which the slow and rapid beats and flutterings and jar will succeed, as before.

Some time before the bridge reaches the mark for $\frac{5}{8}$ths of the string, the flutter and beats will begin again, and decrease, and cease at the minor sixth (6th) just at $\frac{5}{8}$ths of the string, which will prove a consonance, only pleasant in a slight degree, and of a mournful character. Beatings will then again commence, as the bridge is moved on, and increase to the jarring and dissonance so often before mentioned, which will however again give place to a flutter, when something more than $\frac{3}{5}$ths of the string is sounding, and the beats will sound, and at length vanish at $\frac{3}{5}$ths or the major sixth (VI;) the character of which it will not, perhaps, appear easy to define, otherwise, than as greatly inferior to the Vth in sweetness and to the IIId in gaiety, but possessing, in some degree, both these qualities.

Still advancing the bridge, when near to $\frac{9}{16}$ths, and to $\frac{5}{9}$ths of the string, perceptible changes to flutters will be perceived, at the minor sevenths (7 and 7′), and others more discernible when $\frac{8}{15}$ths of the string is passed by the bridge, and the major seventh (VII,) results from the sounding of the two strings. The discordant jar and noise will succeed, until within some distance of the half of the string, when the violent flutters, and rapid and slower beats, will succeed, decrease, and cease entirely, at the true octave or $\frac{1}{2}$ (VIII;) the treble string being then not at all distinguishable from the bass one, if the strings were at first nicely adjusted to each other, as to loudness, and the wheel has continued to act uniformly on each, during the motion of the bridge.

If the bridge be still further advanced, slow and then rapid beats, and flutters, and jars, will succeed &c. as from the unison, as the various notes of the scale are again repeated an octave higher than before.

This interesting experiment, often repeated on the best contrived and constructed apparatus that can be got, will prove very instructing, as to the nature of consonances in general. (ϱ)

CONSONANTS. See GRAMMAR.

CONSTANCE, or CONSTANZ, the name of a town in the Grand Duchy of Baden, beautifully situated on the Rhine, at the south west extremity of the lake of the same name. The chief buildings and objects of curiosity at Constance, are the cathedral, the gates of which, and its principal altar, are deserving of notice; the convent of the Dominicans, which has been converted into a linen and cotton manufactory; the cidevant college of the Jesuits, which is a beautiful building, and the public magazine, with the hall in which the famous council of Constance was held, from 1414 to 1418; and the two chairs in which Pope John XXIII. and the Emperor Sigismund sat when they attended the council. The house where John Huss was seized is still shewn, and upon the walls is his head carved in stone. It has an inscription under it in German, but the head is almost wholly defaced. The dungeon is also shewn in the convent of the Dominicans, in which John Huss was confined, and the very stone to which he was chained. It is about eight feet long, six broad, and seven feet high. The bridge across the Rhine, the fort of Peterhausen on the opposite bank, the Fauxbourg of Paradise, and the place where they raised the pile on which Huss and Jerome of Prague were burnt, are the only other objects worthy of attention.

This town, which was once of some commercial importance, was neglected by the house of Austria, and fell into decay. In 1776, when it was visited by Mr Coxe, the streets were overgrown with grass, and the town had the appearance of being totally deserted; but after the Emperor Joseph had granted to the Genoese emigrants (June 30th 1785) a number of privileges for settling in Constance, the town increased in importance; and, in 1787, when Mr Coxe again visited it, the new settlers consisted of 70 families or 350 persons, of whom 54 were watch-makers. Population 3000. E. Long. 9° 8′ 15″, N. Lat. 47° 36′ 10″. See Coxe's *Switzerland*, vol. i. p. 19.; and Reichard's *Itineraire de Poche de Allemagne et de la Suisse.* (π)

CONSTANCE, LAKE OF, is the name of a large lake which separates Switzerland from the kingdom of Bavaria. It is generally divided into three parts. The Superior or the upper lake is called the *Boden See*; the middle part the *Bodmer See*; and the lower part the *Zeller See.*

The principal branch of the lake, called the Superior Lake, stretches from Constance towards Bregentz, and is about 35 miles long, and 15 miles in its greatest breadth. It is said to be 350 fathoms deep near Mersbourg. Its depth is increased in winter by the melting of the snows. It is surrounded by gently rising hills, with towns, villages, and monasteries, scattered at their base. At the eastern extremity of the lake is a considerable island, on which stands the town of Lindau, which was once a free imperial city, but was transferred, at the formation of the Rhenish confederacy, to the king of Bavaria, who has fortified it and provided it with artillery stores.

The middle or northern branch contains the small island of Meinau, which is about a mile in circumference, and belonged to the knights of the Teutonic order. The house of the commander is beautifully situated, and commands a fine prospect of the lake. The beautiful island of Reichenau is situated in the Zeller See. See Coxe's *Switzerland*, vol. i. p. 16, 21. (π)

CONSTANTIA. See CAPE OF GOOD HOPE.

Constantine I.

CONSTANTINE I. surnamed the Great, was born at Naissus in Dacia, about the year 272. His father, Constantius Chlorus, who, after the resignation of Dioclesian and Maximian, shared the empire with Galerius, was of an ancient and illustrious Roman family, and nearly allied, by the mother's side, to the Emperor Claudius. Distinguished by the humanity and mildness of his character, as well as by his warlike atchievements, he proved a steady and seasonable friend to the Christians; and while the dreadful persecutions which raged during the latter years of Dioclesian, were inundating the eastern provinces of the empire with blood, the Christians in the west, under the mild government of Constantius, enjoyed comparative tranquillity and protection. Helena, the mother of Constantine, was of low extraction, and is even said to have been the daughter of an inn-keeper. She was divorced by the command of Dioclesian, upon her husband's exaltation to the rank of Cæsar, when Constantius married Theodosia, the daughter of the Emperor Maximian. Constantine was then about eighteen years of age. In his youth he had shewn little inclination to store his mind with useful knowledge; but, possessing a comely figure and a vigorous constitution, his attention was chiefly directed to the acquisition of martial accomplishments. He was dexterous in every manly exercise, and, by his courage and affability of manners, he soon became a very general favourite with the army and people. Instead of following his father Constantius to the west, he had resided principally at Nicomedia in the suite of Dioclesian, and for his signal services in Persia and Egypt, had been raised to the rank of tribune of the first order. His popularity and accomplishments, however, had exposed him to the jealousy of Galerius, who, dreading the opposition that he might one day have to encounter from his talents and his power, used every mean of retarding his advancement, and of detaining him at Nicomedia, that he might keep a strict watch over his conduct. When Constantius, who found his health daily declining, desired his colleague to send his son to him over to Britain, Galerius delayed as long as possible, and at last allowed him to depart with the utmost reluctance. Constantine arrived at York just in time to see his father expire, in 306. He was immediately called to the throne by the voice of the army, and Galerius found himself obliged to acknowledge him as sovereign of all the provinces beyond the Alps, but denied to him the title of Augustus. Constantine at first appeared satisfied with this acknowledgment, and employed himself for some years in consolidating and securing the power which he had already acquired. About a year after his accession, he married Fausta, the daughter of Maximian, who had again resumed the purple. He was not allowed, however, to remain long in peace. The ambition of his father-in-law, who attempted to wrest from him his dominions, soon gave him an opportunity of engaging in active warfare; and Constantine continued his career of conquest, until he found himself without a competitor in the empire. But as the reign of this prince forms such an important æra both in the history of the world and of the church, it would be anticipating here what will be more properly introduced under other articles to enter into any particular detail of the transactions of that period. We may only observe, that during the contentions which then agitated the Roman empire, and in which Constantine bore such a distinguished part, he all along displayed not only the qualities of a consummate general, but also the more rare virtues of a merciful conqueror. His government in the western provinces was particularly marked by prudence and humanity; and his victory over Maxentius was unstained by those indiscriminate massacres, of which Rome had been so often the theatre upon receiving a new master. The family of Maxentius, and his most distinguished adherents, were the only sufferers; and though a greater number of victims were loudly demanded by the people, yet the emperor firmly resisted their clamours, and informers were even discouraged and punished. When Constantine, after the defeat and death of Licinius, saw himself sole master of the Roman world, his unabated exertions were still directed to the safety and tranquillity of the empire, which enjoyed fourteen years of almost uninterrupted peace; and the Christian cause, in particular, experienced the happy effects of his auspicious administration. But though success invariably followed his standard, and no ambitious rival attempted to dispute his authority, yet his domestic peace was disturbed by the most afflicting events; and by the murder of an innocent son, and the execution of a guilty wife, a stain has been left upon his character, which no apology can obliterate. Crispus, the eldest son of Constantine by Minervina, his first wife, was a youth of the fairest promise. He had early displayed his military prowess against the Germans; and the naval victory over the fleet of Licinius at the Hellespont, was owing entirely to his intrepidity and skill. His valour and engaging manners had secured to him the esteem of his father's subjects, and they beheld in him a worthy successor to the great Constantine. The emperor, it is said, could not brook a rival, either in the empire or in the hearts of his subjects; and the accomplishments of Crispus only tended to draw upon him the displeasure and jealousy of his father. While his younger brothers, the children of Fausta, were promoted to important commands, he was kept at home neglected and unemployed; and when Constantine was celebrating at Rome the 20th anniversary of his reign, the unfortunate Crispus was apprehended, and without the form of a trial, secretly put to death. A deed so repugnant to the feelings of a father, and so contrary to Constantine's wonted clemency and justice, has been the occasion of much controversy. To seek for a cause for such atrocity, as has been done by some in his jealousy of the fame of his son, would be to rank him with the weakest and the most degenerate of mankind. It has, therefore, been more justly imputed to the artifices of Fausta, who wished to secure the empire for her own children. She poisoned the ear of the emperor with the most groundless accusations of treachery and disloyalty against Crispus: or, according to some authors, Crispus having refused to satisfy her incestuous desires, she insinuated to Constantine, that her honour had been endangered by the designs of his son. Her perfidy, however, was at last discovered and punished; but the aged emperor was left to bewail his hasty condemnation of the noblest and most virtuous of his children. The death of Crispus could not but excite the indignation of the people. Unable to decide upon the nature of his crime, or the justice of his punishment, they yielded to the first impulse of their feelings. He had been too much the idol of their attachment and hopes to be immediately forgotten; and the mysterious secrecy in which his death was involved, was a sufficient ground with them to suppose him innocent, and to estrange their affections from the emperor, whom they now regarded as the murderer of his son. Constantine felt that his popularity was declining; and, having no personal attachment to the ancient capital, he determined to remove the seat of empire to Byzantium, which, under the new name of Constantinople, soon rose in magnificence and splendour to vie with the mistress of the world. The latter years of his life were chiefly employed in this great undertaking, and in settling the disputes of the church, which, though it enjoyed outward peace and tranquillity, was now distracted by the Arian heresy. His exertions, however, in this last respect, were attended but with very partial success. It is true that Arianism was condemned by the council of Nice, and that the emperor declared his determination to maintain the orthodox faith; but the disciples of Arius still prevailed at court, and Constantine, on his death-bed, received the solemn ordinance of baptism from the hands of Eusebius, bishop of Nicomedia, the professed patron of the Arians. He died in 337, at the palace of Aquyrion, near Nicomedia, whither he had gone for the benefit of the air and the warm baths, in the 65th year of his age, and the 31st of his reign. "The excessive demonstrations of grief," says Gibbon, "or at least of mourning, surpassed whatever had been practised on any former occasion. Notwithstanding the claims of the senate and people of ancient Rome, the corpse of the deceased emperor, according to his last request, was transported to the city, which was destined to preserve the name and memory of its founder. The body of Constantine, adorned with the vain symbols of greatness, the purple and diadem, was deposited on a golden bed in one of the apartments of the palace, which for that purpose had been splendidly furnished and illuminated. The forms of the court were strictly maintained. Every day, at the appointed hours, the principal officers of the state, the army, and the household, approaching the person of their sovereign with bended knees, and a composed countenance, offered their respectful homage as seriously as if he had been still alive. From motives of policy, this theatrical representation was for some time continued; nor could flattery neglect the opportunity of remarking that Constantine alone, by the peculiar indulgence of heaven, had reigned after his death."

The character of this prince has been drawn in such a variety of colours, by different writers, that it is difficult to delineate his portrait with any degree of unsuspicious accuracy. The invectives of the Pagan historians, and the flattery of the Christians, are, in all likelihood, equally removed from the truth; and, were we, according to Cardinal Fleury, * to take his vices from Eusebius, and his virtues from Zosimus, he would have so little of either, that his character would not be worth preserving. But in appealing to more impartial authorities, a tolerable estimate may be formed of those qualities for which this great prince was more particularly distinguished. The general tenour of his administration was marked by wisdom and justice. He was indefatigable in business; and always ready to hear and to redress the grievances of his subjects. As a soldier, he was equalled by none in the disastrous times in which he lived; and from the beginning of his career until he became undisputed master of the empire, he showed, in every enterprize, the most consummate skill and personal valour. His troops were always animated by his example; and, "to his abilities rather than to his fortune," says Mr Gibbon, "we may ascribe the signal victories which he obtained over the foreign and domestic foes of the republic." The early part of his reign, indeed, has been highly panegyrised by this historian, but we have reason to suspect his sincerity, and cannot help believing that his design in doing so was, that he might, with the greater appearance of candour, consign to infamy the memory of the first Christian emperor. "In the life of Augustus," says he, "we behold the tyrant of the republic, converted, almost by imperceptible degrees, into the father of his country and of human kind. In that of Constantine, we may contemplate a hero, who had so long inspired his subjects with love, and his enemies with terror, degenerating into a cruel and dissolute monarch, corrupted by his fortune, or raised by conquest above the necessity of dissimulation." This may, no doubt, be considered more as a rhetorical flourish, than as the grave dictate of historical truth, and therefore is not to be taken in its literal acceptation; but such language is very inconsistent with that impartiality of which this author so often boasts: and allowing even the credibility of every vice with which he has deformed the latter years of Constantine, and by which he has attempted to expose him to ridicule and contempt, it would by no means warrant such a severe and indiscriminate censure. That Constantine in the latter part of his reign was too prodigal of the public money; that the enormous expences which attended his administration, and the stately buildings with which he adorned his new city, could only be supported by an increased taxation, must be acknowledged; that he assumed too much, both in his dress and manners, the state of eastern magnificence, we will also allow; nor will we attempt to palliate even his conduct towards his son Crispus; yet taking into account every failing with which he has been charged, and rejecting all the panegyrics of the Christian fathers in his favour, we would with greater justice give a summary of his character in the words of an ancient Pagan, than in those of the modern which we have quoted above: *In primo Imperii tempore optimis principibus, ultimo mediis comparandus.*

The religious character of Constantine has been equally the subject of controversy and animadversion. Some have attributed his support to the Christian cause entirely to political motives, and maintain, that he was no more convinced of the divinity of Christianity, than he was of the divinity of Paganism; but that he encouraged it, as the most effectual means of uniting mankind under his government. That Constantine shewed the greatest respect for Christianity from his first assuming the purple; that he recommended its doctrines to his subjects; and that he continued his attachment and protection to its disciples until his death, —no one surely will attempt to deny. If an uniform course of conduct, then, be any evidence of inward sentiments, we have the most convincing proofs, that Constantine believed in the divinity of the gospel. Whether his heart was suitably influenced by its sublime truths, is a different question. But there can be no doubt, that he preferred it to every other religious system, when he made it the established religion of the empire. That Constantine might have been induced to become the friend of the Christians, in conformity to the wishes of his dying father, we may believe; that he might have been led to support them, from early prejudices in their favour, or from those feelings of sympathy which are always the attendants of true magnanimity, we can also easily conceive; but

* "On ne se trompera point sur Constantin, en croyant tout le mal qu'en dit Eusebe, et tout le bien qu'en dit Zosime." Fleury *Hist. Eccles.* tom. iii. p. 233.

that a prince should embrace such opinions from political motives, appears to us scarcely within the bounds of probability. When Constantine began his career of ambition, the Christians were an insulted and despised sect. The persecutions, which raged with such fury in the reigns of Dioclesian and Maximian, were still continued under their successors, and exceeded in cruelty all that had ever afflicted the Christian church. The bloody Maximian vowed to Jupiter, that if he was successful in his contest with Licinius, he would extirpate the Christian name; and on a medal of Dioclesian, which was struck at that period, and which is still extant, is this inscription,—*Nomine Christianorum deleto:* the name of Christians being extinguished. The mild Constantius, even when he held the rank of Cæsar in Gaul, was compelled by the edicts of Maximian to destroy the churches, though he continued to respect the persons of the Christians. To espouse such a cause, then, was not the most likely road to the object of his ambition. It inevitably exposed him to the derision and opposition of the Pagans, who composed the armies of his rivals, and perhaps the majority of his own; and could only serve to collect under his standard the few Christians who had escaped the rage of their enemies. Had Constantine, therefore, regarded Christianity, as was done by the learned Pagans of that age, as "old wives' fables," or as a superstition which threatened the republic with ruin, it would have been folly to have hazarded his success by such a step, while by an opposite conduct he could more easily have secured the affections of the Roman people, who were now weary of their tyrannical masters. He must, consequently, have believed in the truth of Christianity, or supposed it at least of equal authority with the polytheism of the Pagans; and it is probable, that he hesitated long before he came to the final resolution of destroying the temples of the gods, and of declaring himself a faithful disciple of the cross. Much has been said respecting the date of his conversion; but this is not a subject for man to explore; for, whether he was suddenly or gradually brought to the knowledge of Christianity, or whether indeed he had ever such views of divine truth as the gospel requires, can only be known to the Searcher of hearts. He had been, no doubt, early taught to revere the name of Christ. In the palace of Constantius were many Christians, and even ministers of the gospel, who openly prayed for the emperor; and the opinions and conduct of such a father could not but have a considerable weight with his intelligent son. Though, when resident at the court of Dioclesian or Galerius, he did not shew, at least was deterred from shewing, any partiality for the persecuted sect, yet as soon as he found himself beyond the reach of their authority, and at liberty to act according to his own judgment, he declared himself the friend of the Christians, by continuing to them that protection which they had enjoyed under his father; and from that period, every victory which he obtained was only an additional triumph to the cause of Christianity. With respect to the luminous appearance of a cross in the heavens, which he is said to have seen with his whole army when marching against Maxentius, and to which, with the heavenly vision of the subsequent night, Eusebius ascribes his conversion, much has been written to little purpose.* We confess, that the evidence for this fact appears to us neither so full nor so satisfactory as could be wished in a case of such a miraculous nature; but though we may hesitate in giving it implicit credit, we can see no reason for rejecting it, as many have done, on the ground of improbability. To them who admit the divine origin of Christianity, and are disposed to believe that God has interposed at any time in behalf of the church, this miracle must appear both credible and proper; for scarcely was there a time, when the importance of the contest called more for such an interposition. But whatever credit be attached to this miracle, it is a well known fact, that Constantine, in one of his first edicts which he published after the death of Maxentius, abolished throughout his dominions the punishment of the cross; and what was formerly an object of horror to every Roman citizen, he rendered a badge of distinction and valour, by placing a cross in the right hand of his own statue at Rome, with an inscription which referred the victory of his arms to the virtue of this sign. "The same symbol," says Mr Gibbon, "sanctified the arms of the soldiers of Constantine; the cross glittered on their helmet, was engraved on their shields, was interwoven into their banners; and the consecrated emblems which adorned the person of the emperor himself, were distinguished only by richer materials, and more exquisite workmanship." Those who are inclined to question Constantine's sincerity in the profession of Christianity, may be referred to the invariable tenor of his government. In all his public edicts, the church seems to be the chief object of his regard. He increased its privileges, honoured its pastors, and attended its worship; and he shewed, that he had in some degree imbibed the mild and forgiving spirit of the gospel, for, while he earnestly recommended to the governors of provinces to extend its influence among his subjects, he declared, that he would compel no one to embrace it contrary to his inclination. He has indeed been charged, and justly too, with many actions very inconsistent with the pure dictates of that religion which he professed; but if this is to be taken as an evidence of his insincerity and dissimulation, the same argument may be applied to some of the most eminent bishops of his own time, and also to many sincere professors of the present day. His delaying to receive the initiatory rite of baptism to so late a period of his life, has been most satisfactorily accounted for. Christianity had considerably degenerated from that simplicity and pure morality, for which it was so eminently distinguished under the apostles. Many superstitious ceremonies and unmeaning forms had crept into its worship; and, as many of its professors had been taught to believe a necessary connection between baptism and the remission of sins, they delayed this rite as long as possible, that they might ascend pure and spotless to the mansions of immortality. In reviewing the character of this prince, we would conclude with observing, with the candid Lardner, "that we should be willing to make allowances in favour of princes, and especially of long reigns. It is next to impossible for human wisdom and discretion, in the course of many years filled

* The fact is thus abridged from Eusebius by Milner: "While he was marching with his forces in the afternoon, the trophy of the cross appeared very luminous in the heavens, higher than the sun, with this inscription, τȣτω νικα, "conquer by this." He and his soldiers were astonished at the sight; but he continued pondering on the event till night And Christ appeared to him when asleep, with the same sign of the cross, and directed him to make use of the symbol as his military ensign. Constantine obeyed, and the cross was henceforward displayed in his armies." Milner's *History of the Church of Christ*, vol. ii. p. 41.

Constantinople.

with action, not to be surprised into some injustice, through the bias of affection, or the specious suggestions of artful and designing people. Though, therefore, there may have been some transactions in this reign which cannot be easily justified, and others that must be condemned, yet we are not to consider Constantine as a cruel prince, or a bad man." See Lardner's *Credibility of the Gospel History*, vol. vii. Gibbon's *Roman Empire*, vol. ii. p. 190, and vol. iii. p. 99, 8vo. Milner's *History of the Church*, vol. ii. c. i. and ii. Esprinchard, *L'Histoire Auguste, ou les vies des Empereurs Romains*, vol. i. p. 520. Mosheim's *Eccl. Hist.* vol. i. p. 320. (*p*)

CONSTANTINOPLE, called by the Turks *Stamboul*, the ancient *Byzantium*, and capital of the Turkish empire, stands on the western shore of the Thracian Bosphorus. This strait, which divides Asia from Europe, and joins the Euxine with the Mediterranean Sea, affords an easy communication with the most fertile regions and principal nations of the three continents; and points out Constantinople as admirably situated for being the centre of a rich and extensive commerce. † The situation of the city is also equally remarkable for beauty and security. It is built upon seven hills, which appear to rise above one another in beautiful succession; and has the figure of an unequal triangle, with the base facing the west, and the obtuse angle jutting into the sea. Its northern side is bounded by an arm of water navigable for several miles, and which forms a safe and commodious harbour. On the south, it reclines upon the sea of Marmora; and towards the land it is defended by a strong wall, with a triple fortification 18 feet distant from each other. This wall, notwithstanding the effects of time, and the many memorable sieges which the city has sustained, is still in great preservation. It is flanked with lofty towers of various shapes, and has five gates, with stone bridges over the foss, which is 25 feet wide, and, in many places, decorated with trees of great beauty and variety. The most remarkable of these gates, though the most ruinous, is the Porta Sancti Romani, which first yielded to the barbarous valour of the Turks, and where the emperor Constantine Paleologus, its magnanimous defender, was slain. The wall is composed of large flat bricks and freestone laid in alternate courses; and the internal arcades and rooms in the towers are all of brick, and of most curious construction. The fortifications towards the sea are in a more decayed state, and are partly destroyed. At the southern extremity of the city is a small fort, called by the Turks Yeddikuli, or the seven towers. It was built by some of the Greek emperors, probably John Zimitzes, in 1000, and had originally only four towers. Other three were added in 1458 by Mahomet II., who also rebuilt a great part of it, and converted it into a state prison. This fort forms a tolerably regular pentagon; and the area of the whole inclosure, according to Dr Pouqueville, is about 5500 square toises. All the five angles were formerly flanked by towers with conical roofs, which give them a clumsy and mean appearance; but of these one was thrown down by an earthquake in 1768, and another is falling fast into decay. On the front, towards the west, stands the ancient triumphal arch of Constantine, with a marble tower on each side. Both these towers are enormous masses with platforms at the top, but are only between 80 and 90 feet high, and scarcely overtop the adjacent walls. This place is now chiefly used by the Turks for confining the ministers and ambassadors of the powers with whom they happen to be at war.

Situation.

Walls and gates.

Fort of the Seven Towers.

The walls of Constantinople inclose an area of about 2000 acres, and its total circumference is from twelve to fourteen English miles. The summits of its hills are covered with innumerable mosques and baths, intermixed with lofty cypresses; and their declivities are crowded with habitations and terraced streets. The multitude of houses painted of different colours, the gilded domes, and the elegant and slender minarets, crowned by the shining crescent, impress the beholder with a high idea of its magnificence and splendour. The interior of the city, however, but ill corresponds with the beautiful *coup d'œil* which it presents at a distance. "To say something of Constantinople, in general," says Mr Sandys, "I think there is not in the world any object that promiseth so much afar off, and entered, that so deceiveth the expectation." It consists of an assemblage of dark and narrow streets without names, badly paved, and choked either with dust or mud. The office of scavenger is left entirely to the dogs and vultures, which prowl about during the night; and the only time that the streets are tolerably clean is after rain, which, owing to their declivity, washes away and carries off the filth. The houses are constructed of wood and earth, and are, in general, low and mean, full of unglazed windows, and without chimneys. The best apartments are always appropriated to the Harem, and are remarkable for the neatness and elegance of their furniture. None of the houses, however, are allowed to exceed twenty-six feet in height, which gives the streets a very mean appearance. Indeed there is scarcely a tolerable street in all Constantinople; and if the Turks claim for their capital the appellation of new Rome, it must be owing entirely to its public edifices, which being interspersed among its crowded lanes, diffuse over it an air of gloomy magnificence.

Streets.

Houses.

On the eastern promontory, stands the palace and gardens of the Seraglio, which cover one of the seven hills, and occupy the site of the Byzantine republic. This spot was judiciously chosen by Mahomet II. for his imperial palace. In 1478, he enclosed with lofty walls an area of about 150 acres, which he destined to be the seat of Turkish jealousy and despotism. Succeeding Sultans have beautified and enlarged its buildings; and the whole space is now covered with detached suites of apartments, mosques, baths, gardens, and cypress groves. So many glittering domes, rearing their lofty heads above the verdant foliage and painted terraces, produce at a distance a very beautiful effect, which, however, is entirely lost upon a nearer inspection; for they are huddled together without symmetry or order. The principal entrance is on the west, through the Baba-hoomajin, or Sublime Porte, which is built of marble, and has a very heavy appearance. It is here that state delinquents are decapitated, and their heads exposed for three days. In front of this gate is an extensive and irregular area, the ancient Augusteum, having in the centre a richly ornamented fountain built by Achmet III.; and on the north the magnificent church of St Sophia. Within is the first court, which contains

Seraglio.

† "Est in Europa; habet in conspectu Asiam. Ægyptum Africamque a dextra: quæ tametsi contiguæ non sunt, maris tamen navigandique commoditate veluti junguntur. A sinistra vero Pontus est Euxinus." *Busbequius*, Epist. i. p. 64.

Constantinople. the mint, and the vizier's divan; and opposite is the Baba-Salem, or gate of Health, which leads to the second court, where is the audience chamber, in which foreign ambassadors are received by the Sultan in person. In this chamber is the throne, which resembles a large four-posted bed; the posts are inlaid with precious stones; the canopy is of velvet, fringed with jewels; and the cushion upon which the sovereign sits, is composed of a massy embroidery of pearls. The gate which terminates the second court, is called Baba-Saadi, or the gate of Happiness, and through which no stranger is allowed to pass. Beyond it are scattered a rich profusion of buildings, terraces, and flower gardens, where are immured above five hundred unfortunate females, devoted to the pleasures of a single master. Seldom has love or pleasure been known to reside within these abodes of luxury. Whatever can minister to the vanity of its inhabitants is amply provided: sumptuous apartments, splendid dresses, and a variety of amusements; but they are tormented with the most corroding passions, and are incessantly engaged in intrigues of rivalship. Many are doomed to waste their beauty in vain attempts to please a master, who often receives them with disdain; and others are sacrificed, by the application of poisonous drugs, to the jealousy of a rival. The furniture of the palace is distinguished more by its richness than its variety. It consists chiefly of the sofa spread round the room, the carpets, and the mirrors. The walls are wainscoted with jasper, veneered ivory, and mother-of-pearl; and the hangings are of silk and cloth of gold, with fringes strung with pearls, and inferior jewels. The gardens are laid out in a very inferior style, more after the taste of Holland than of any other country. "Various and very despicable *jets d'eau*," says Dr Clarke, "straight gravel walks, and borders disposed in parallelograms, with the exception of a long green-house filled with orange trees, compose all that appears in the small spot which bears the name of the Seraglio gardens." The library of the palace is said to contain several valuable manuscripts, both Greek and Latin, as well as Oriental. Many of them are kept in confused heaps, without either catalogue or arrangement; and some have pretended, that the original gospel of Matthew in Hebrew, and the last books of Livy and Diodorus Siculus, are among the number. This, however, is merely conjecture, which rests upon very questionable grounds. It is said, that Pope Nicholas V. offered 5000 sequins for the gospel of Matthew, and that the Grand Duke of Florence made an offer of 5000 piasters, which was doubled by the Bailo of Venice, for the MSS. of Livy, but neither of them were produced. It is impossible, indeed, to ascertain, with any degree of precision, the real contents of this library, as it is inaccessible to Christians.

[Ol]d Seraglio. The old Seraglio occupies the third hill, which is nearly in the centre of the city, and is surrounded by a lofty wall about a mile in circumference. It is now appropriated to the reception of the wives and harems of the deceased, or deposed sultans. They are here treated with considerable distinction, but are secluded for life, as it is considered indecent that a slave, who has enjoyed the favours of a Sultan, should pass into the possession of another man. Such of the young ladies of the harem, however, as are declared to have been unknown to him, are generally united to some of the courtiers of his successor.

St Sophia's Church. Among the numerous mosques and public edifices which adorn Constantinople, the first place, both for magnificence and elegance of architecture, is due to the church of St Sophia, which seems to have served as a model for all the rest. (See Civil Architecture, vol. vi. p. 625. and Plate CLXXIII.) It stands, as we have already observed, on the north side of the ancient Augusteum, near the principal gate of the Seraglio. It is the first erected Christian church now existing, and was built by Constantine the Great, and dedicated to St Sophia, or the "Inspired Wisdom." During the reign of Justinian, however, it was completely destroyed by fire in a popular sedition, when that emperor ordered it to be rebuilt with greater sumptuousness and elegance, under the inspection of the most celebrated architects of the time, Anthemius of Tralles, and Isidorus of Miletus. It was finished in eight years and five months, and, according to the lowest computation, at the expence of one million sterling. Most travellers, who have visited Constantinople, have given a description of this church, but in general with such confusion or obscurity of narration, that it is difficult, from their statements, to convey to our readers any correct idea of its several parts; and it has been very justly observed by an intelligent and classical traveller of the 17th century; "a long labour it were to describe it exactly, and having done, mine eyes that have seen it would but condemn my imperfect relation." (Sandys' *Travels*, p. 24.) The most scientific idea of its architecture, will be derived from consulting Grelot *Voyage de Constantinople*, and the engravings published by Banduri in his *Imperium Orientale*. It is said to be built in the form of a Greek cross with a dome, which is constructed with so small a curve, that the perpendicular concavity does not exceed one-sixth of the diameter. This flatness is, in general, much admired; and, "if the great vault of heaven be the idea intended," says Mr Dallaway, "with a happier imitation than in St Peter's at Rome." The outward appearance of this building, however, owing to the heterogeneous additions which have been made to it, presents only a pile of unsightly masses. It was propped with two immense buttresses by Andronicus in 1317; and four minarets have been added by the Turks, which, however, give it an air of lightness that it would not otherwise possess. Its exact length from east to west is 269 feet, and its breadth 243. The principal vestibule, which is on the west, is 28 feet wide, and has nine doors of bronze, magnificently wrought in alto relievo. The interior of the church, though many of its ornaments have been defaced by the Turks, still retains much of its ancient grandeur. The grand dome has a regular tier of windows, and rests upon four arcades, connected with as many cupolas, which blending with the principal one, forms an immense expanse of roof. The whole has been originally ornamented with mosaic work upon a golden ground; but the Mahometans have covered it completely over with white wash. The spacious floor is entirely devoid of seats and benches, and is covered with the richest carpets; and from the roof are suspended innumerable lamps of coloured glass, intermixed with globes of crystal, ostrich eggs, and ornaments of gold and silver, which, when illuminated, give a grand effect to the stupendous concave. Among the numerous pillars which adorn this mosque, are six of green jasper, which once supported the roof of the temple of Diana at Ephesus; and eight of porphyry, that had been placed by Aurelian in the temple of the Sun at Rome, but were removed hither by Constantine. St Sophia was dedicated to Islamism by Mahomet II., and still retains the revenue which it enjoyed when a Christian church. This revenue, which arises from a species of tenure called *vacuf*, in some measure analogous to

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church lands with us, amounts to nearly 3000*l.* a year, which is employed in keeping the mosque in repair, and in paying the stipends of the officiating imams.

Mosques.

Besides St Sophia, there are several other very handsome mosques, many of which were originally Greek churches. The imperial mosques, especially those which have been built by particular Sultans, appear nearly equal to that of St Sophia, though, upon a nearer inspection, their inferiority is obvious. Of these, the principal are, that of Mahomet II. which crowns one of the seven hills, and stands upon the site of the celebrated church of the apostles, built by Theodosia the wife of Justinian; that of Achmet I. which was constructed in 1610, at an enormous expence, and has six minarets of extraordinary height and beauty, but the internal embellishments are gaudy and irregular; that of Bajazet, in which are twenty columns of remarkable size and value, viz. ten of verd antique, four of jasper, and six of Egyptian granite; that of Solyman II. which is esteemed of superior symmetry and elegance, and was constructed from the materials of the church of St Euphemia at Chalcedon. The mosque of Laleli, or the Tulip, is small, but very elegant, and was built by Sultan Mahmood in 1753. It is wainscoted with veneered marble, and has two large embroidered tablets, on which are represented the cities of Mecca and Medina. Every mosque has, in general, a large area in front, surrounded by a lofty colonnade of marble with gates of wrought brass, and in the centre are fountains of polished marble. Adjoining to each is the sepulchral chapel of its founders, where his remains are deposited, and sometimes such reliques as are worth preserving. In that of Sultan Mahmood, is the Koran written with his own hand. These mosques have also an hospital and academy attached to them, where students are educated and maintained upon the foundation. Of the Christian churches in this city, the Greeks have twenty-three, including the patriarchal church; and the Armenians three. There are six Roman Catholic convents, and several Jewish synagogues, also a Swedish Lutheran church.

Atmeidan, or horse-course.

Among the antiquities of Constantinople, the Atmeidan, or horse-course, deserves particular attention. It is the ancient circus, or Hippodrome of the Greeks, so constantly occupied by public games and exhibitions, and it still continues to be the scene of most of the public ceremonies and processions of the Turks. The area is about 250 paces in length, and 150 in breadth, but its sides are very irregular. On the east is the mosque of Sultan Achmet, and on the west the ruins of a large building, supposed to have been the questor's palace, part of which is now appropriated to the reception of lunatics, and another part is used as a menagerie. Of the numerous statues and obelisks with which the circus was anciently ornamented, during the Greek empire, few have escaped the fury of the Turks, and the earlier ravages of the French and Venetians. An obelisk of superior workmanship, which stands near the centre of the area, is composed of a single block of Egyptian granite 60 feet high, and is inscribed with Egyptian hieroglyphics. It was brought from Thebes by Theodosius the elder, and erected at Constantinople, by means of curious machinery, in 32 days. The base is of white marble, seven feet in height, and sculptured with bas-reliefs representing the emperor presiding at the circus games. The Greek and Latin inscriptions are now almost sunk under ground, or totally obliterated. Towards the south end of the area is the serpentine pillar, a singular fragment of antiquity, which is confidently said to have once supported the golden tripod which was consecrated by the victorious Greeks in the temple of Delphos, after the defeat of Xerxes. It is of wreathed brass, about twelve feet high, and formerly terminated at the top, with figures of three serpents rising from the pillar, and with necks and heads forming a beautiful triangle. The lower jaw of one of the serpents was shattered by Mahomet II. with a stroke of his battle-axe; and we are told by De La Mottraye, that during his stay in Constantinople, in the year 1700, the other two heads were stolen by some unknown depredator, but who was generally suspected to be a servant of the imperial ambassador. Chishull, however, mentions in general, that they were broken off by some attendants of the Polish ambassador who lodged in the neighbourhood. The Atmeidan still serves as a place of equestrian exercise; and it is here that the Turks practise upon horseback, a kind of military game called *djirit,* to which the young men of fashion are trained from their childhood as a necessary accomplishment. This game consists chiefly in darting at each other, with great violence, the djirit, a white wand of about four feet in length; and their skill is shewn by avoiding the stroke, in pursuing their adversary, in checking their horses in full gallop, or in stooping from them to reach the djirit from the ground. This exercise requires great agility and strength, and is both fatiguing and dangerous.

Aqueduct of Valens.

The other remains of Grecian architecture are the aqueduct of Valens, and some triumphal columns. The former, which conducts the brook Hydrale from Belgrade, was constructed with materials from the walls of Chalcedon; and connects the third and fourth hills by more than 40 arches. It was repaired in 570 by Justin the younger, and almost completely renewed by Solyman the Magnificent. The columns still to be seen are those of Constantine, Marcian, and Arcadius. Of the latter, however, the base only remains, which is 14 feet high, but all the sculpture is defaced. The shaft, which was covered with a series of bas reliefs representing the victory of his father Theodosius over the Scythians, was, on account of its ruinous state, taken down in 1695. That of Constantine is the most perfect, and is called by the Turks "the burnt pillar," having suffered greatly from frequent conflagrations. It stands upon a pedestal of white marble nearly twenty feet high, and is composed of huge blocks of porphyry about 33 feet in circumference, with circles of embossed brass to conceal the joints. On the summit stood a colossal statue of Apollo, in bronze, supposed to have been the work of Phidias, but it is now overthrown, and the porphyry is discoloured and cracked by the fire. The column of Marcian stands in a small enclosure or garden, and is surmounted by a capital of the Corinthian order, which is rather disproportioned to the shaft, and is unclassically rich in ornaments.

Fountains and baths.

As frequent ablutions are commanded by the Koran, and are also required by the exigencies of the climate, there are within the walls of Constantinople 130 public baths; and fountains are to be found in almost every street. The baths of the Greeks were continued by their Turkish conquerors; and those of Zeuxippus, Arcadius, and Eudoxus, were dedicated to the service of the public. Many more have since been erected, but they are all nearly of the same plan; and some of them are very elegant buildings of hewn stone, having the inner chambers paved with slabs of beautiful marble. The use of the bath in Turkey is very different from our method of bathing, and resembles rather the lustra-

Constantinople. tions of the ancients, which is in every respect both more luxuriant and refreshing. The fountains are low square buildings, with leaden roofs. They are, in general, profusely covered with gilding and a variety of colours, and inscribed with verses.*

Bazars. The bazars of Constantinople are very extensive, and form numerous streets, where articles of every description are daily exposed to sale. They consist of lofty cloisters, built of stone, and lighted by domes, which are admirably adapted for the climate, and in summer afford a cool and pleasant retreat. Every trade has its particular quarter; and each dealer has a small shop in front, with a room behind for his wares. In one street, nothing is to be seen but arms of different kinds; another is filled with jewels, diamonds, and precious stones; some are lined with India stuffs, with brocade of silver and gold, while others are set apart for Egyptian minerals and drugs; or for booksellers, who have always on sale an excellent assortment of Arabic, Turkish, and Persian MSS. Whole streets are occupied by shoemakers, furriers, pipe-makers, cooks, or confectioners, &c. each being confined to its distinct district. The different trades are also appropriated to different nations; and each has the proper costume of his respective country or profession, which forms a curious and almost infinite variety of dress and appearance.† Every evening the bazars are shut at an early hour, and no one is allowed to remain but the guard. There are also khans, or hotels, built of stone, and fire proof, where merchants, from all quarters of the empire, who travel with caravans, find ample accommodation both for themselves and their merchandise. The Avret bazars, or woman-market, is held in an inclosed court, surrounded with a cloister and small apartments. Here female slaves, from different countries, are publicly exposed for sale every Friday morning. Those from Egypt and Abyssinia are generally purchased for domestic purposes; while the Georgians and Circassians are reserved for the seraglio, or the harems of the opulent, and are usually sold for several thousand piastres.

Suburbs. The suburbs of Constantinople, which are very extensive and populous, stretch chiefly towards the north beyond the harbour. Of these, the principal are Galata, Pera, and Scutari. *Galata,* which lies on the water side, was built by a colony of Genoese, who, in 1261, obtained from the Greek emperors the privilege of being governed by their own magistrates; and this colony increased so rapidly in commercial consequence, that, before the conclusion of a century, they extorted from Michael Paleologus the liberty of surrounding their city with a strong wall. They soon afterwards became the most determined enemies of the empire, and are supposed to have afforded assistance to the Turks in the last siege of Constantinople. The walls formed a circuit of nearly four miles, but they are now in ruins; and the place is chiefly inhabited by merchants of all nations, who are confounded under the general name of Franks. They prefer it to Constantinople, on account of its vicinity to the harbour, and also because most of the buildings are fire-proof. A Turkish guard is stationed at each of the gates, which are always shut after sun-set, except the one leading to Pera, which is opened at almost any hour of the night, for the accommodation of the Franks, who annually pay a small sum to the chief of the guard for this privilege. *Pera* stands immediately above Galata, and stretches for more than two miles along the summit of a lofty hill. The houses, with a few exceptions, are built of wood and unburnt bricks. The streets, in general, intersect each other, and are narrow, ill paved, and irregularly built. The air, however, is uncommonly healthy, the prospect delightful, and the town is well supplied with water. Pera has long been appropriated for the residence of the corps diplomatiques from the different nations of Europe, who have each of them a palace here; and the inhabitants are judged by the laws, or the ambassador of the nation that protects them. Formerly no person was allowed to build or to reside here, unless such as were attached to these missions; but of late it has become the abode of the most wealthy of the Greeks and Armenians, who find themselves more at liberty here, and less exposed to exactions and insults, than under the government of the Turks. *Scutari,* the ancient Chrysopolis, which lies on the Asiatic side of the channel, is also considered a suburb of Constantinople. It is situated on a sloping ground, and has a very picturesque appearance, from the mixture of trees, houses, mosques, and minarets. It serves at present as a rendezvous and an emporium to the caravans of Asia; but it is chiefly distinguished for its extensive burying grounds, which are the handsomest in the Ottoman empire, both from the luxury of the tombs, and the height and closeness of the trees. These cemeteries extend for some miles on the east and south of the town, towards the sea. The rich Turks of Constantinople prefer this spot to any on the European side, from the belief, which seems to be very generally entertained among them, that their capital will one day be regained by the Christians; and, consequently, they wish to escape the disgrace of having their ashes trodden on by the infidels. To these may be added Tophana, or the cannon foundery, which lies on the north side of the harbour, near Pera, and opposite to the seraglio; and the village of Eyub, which received its name from Eyub, or Job, the standard-bearer of Mahomet, who was killed in the first siege of Constantinople by the Saracens; and to whose memory Mahomet II. having discovered the place of his sepulture by a revelation, erected a mausoleum and mosque.

Environs. The environs of Constantinople, except on the shores of the channel, exhibit, in general, nothing but naked and waste lands, without verdure or inhabitants. Though the soil is every where adapted for various kinds of corn and fruits, yet cultivation is almost entirely neglected, and horticulture scarcely known. The Greeks have attempted to sow some of these waste lands, and have been repaid with most abundant crops; but unless the government take some more effectual measures for repressing the devastations and pillage of the Turks, and of securing to the agriculturists the produce of their industry, this good example will be but slowly imitated. On the banks of the channel,

* In a description of Constantinople, composed about a century after its foundation, there are enumerated, a capitol or school of learning, a circus, two theatres, eight public, and 153 private baths, 52 porticos, 5 granaries, 8 aqueducts or reservoirs of water, four spacious halls for the meeting of the senate or courts of justice, 14 churches, 14 palaces, and 4388 houses, which, for their size or beauty, deserved to be distinguished from the multitude of plebeian habitations. Gibbon's *Roman Empire,* vol. iii. p. 20.

† Dr Pouqueville, in his Travels in the Morea, &c. has given a list of the arts and trades carried on in Constantinople, with the nations by whom they are exercised. See p. 288.

Constantinople. however, are several elegant palaces with beautiful hanging gardens; and a few vineyards and kitchen plants are to be found in the environs of Pera. "Within a mile of the suburbs," says Mr Dallaway, "the gorgeous fanes of the capital rise as from a desert at the call of a magician; and the beautiful *chiftlik*, or country seat of Daoot Pasha, flourishing amidst a dreary waste, confirms the idea of his residence there." Washed on two sides by the sea, Constantinople enjoys a climate which may be considered as particularly healthy. It is never subject to such a degree of heat, as to be really deleterious, or to any severity of cold. Fogs are very rare, and the heavens are seldom obscured by clouds for any length of time. The average of the climate, in ordinary years, is estimated, by Dr Pouqueville, at 66 days of rain, 4 of snow, 6 of fog, 20 cloudy, 40 variable, 15 thunder, which leaves 214 almost uniformly serene. Thunder storms are not frequent, but very tremendous; and earthquakes are not uncommon. Whatever is unwholesome about this city, arises entirely from the indolence of the inhabitants, and the negligence of the government.

Harbour. Constantinople possesses one of the finest harbours in the world, both for security and convenience. It lies on the north of the city, which it separates from the suburbs of Galata and Pera, and is formed of an arm of the Bosphorus. From the seraglio point, to where it receives the waters of the river Lycus, it is about seven miles in length, and its breadth at the entrance is about 500 yards. It is capable of containing above 1200 ships; and, from the curve which it describes, and the rich cargoes which were continually wafted thither, it obtained, at a very remote period, the name of the Golden Horn, which it still retains. Owing to the vicissitudes of the tides being scarcely felt in those seas, and the steepness of the banks, ships of any burden can approach close to the shore, and unload their cargoes with very little trouble. The ships of war are generally moored on the city side of the harbour, while those of commerce are stationed at Galata. The whole of the canal is almost constantly filled with ships of different nations, who are obliged to stop here for a bill of health before they can enter the Black Sea, or for a passport to the straights of the Dardanelles.

Commerce. Upon entering the harbour of Constantinople, and beholding for the first time the immense quantity and variety of shipping, the bustle that appears on the quays, and the numerous boats that continually cover the water, a stranger would be led to rank this city among the most opulent and flourishing in Europe. "The ships, however, which crowd its port," says Dr Clarke, "have no connection with its welfare: they are for the most part French, Venetian, Ragusan, Sclavonian, and Grecian vessels, to or from the Mediterranean, exchanging the produce of their own countries for the rich harvests of Poland; the salt, honey, and butter of the Ukraine; the hides, tallow, hemp, furs, and metals, of Russia and Siberia; the whole of which exchange is transacted in other parts, without any interference on the part of Turkey." The commerce of this city is consequently very inconsiderable, compared with its extent and population; and its inhabitants seem incapable of appreciating the advantages of their situation. Under a wise government, they might obtain the riches of all the empires of the earth; but in their present state, they can scarcely obtain sufficient for their daily consumption.

Imports. From England they receive lead, tin, watches, all sorts of clock-work, hard-ware, woollen cloths of different qualities, spices, and glass-ware; but as they have no manufactures to give in return, the ships of that country are obliged to take in their lading at Smyrna. The Russians supply them with skins for pelisses, &c. cloths, and other manufactures, and take in return dressed leather, oranges, lemon-juice, and some dried fruits. They receive from France woollen cloths, wrought silks, caps, paper, sugar, cochineal, indigo, gold lace, and an infinite quantity of trinkets, and other trifles, for which they give grain of all kinds, coffee, goat's hair, cotton, wool, silk, &c. The Venetians carry thither a small quantity of gold stuffs, and a species of damask called Damasquetti, of which they make a considerable sale; also sweetmeats, glass, paper, drugs, wax candles, &c.; and receive in return leather, wool, cotton, wax, ashes of Cyprus, oil of Candia, coffee, and Cyprus wines. The following are their principal articles of importation, with an average calculation of their annual consumption and price.

Articles.	Quantity.	Price.
Tin, ...	400 barrels, .	160 to 170 piastres per kintal.
Tin plates, .	300 boxes, . .	155 to 250 do. the pair of boxes.
Shalloons, .	200 bales, . .	55 to 100 do. per piece.
Cotton yarn,	300 bales, . .	about £100,000.
Indigo, . .	350 seroons, .	34 to 46 piastres per oke.
Cochineal, .	60 barrels, .	65 to 100 do. per oke.
Dye-woods,	500 kintals, .	25 to 35 do. per kintal.
Pepper, . .	500 kintals, .	$2\frac{1}{2}$ to 3 do. per oke.
Vitriol, . . .	160 bottles, . .	5 do. per oke.
Rum, . . .	100 puncheons,	5 to 7 do. per gallon.
Loaf-sugar,	150 hhds. . . .	150 to 170 do. per kintal.
Raw and powdered do.	600 hhds. . . .	100 to 140 do. per kintal.
Watches, . .	15,000	
Rabbit skins,	20,000	2 do. each.

Cloth, 40 bales of British, the rest French and German.

Muslins. Those from India and Germany are preferred.

Printed cottons and Indian ginghams are much used.

Jewellery to a great amount, also arms and cutlery, but of British manufacture only about £5000 worth.

Glass and furniture in considerable quanties.

Exports. The exports of Constantinople are very inconsiderable; and of those articles which formerly constituted this branch of trade, they have now scarcely a sufficiency to supply their own wants. Indeed the Turks have no merchandise to give which are nearly equal to the value of their imports, and consequently the return is made almost entirely in gold, money, and diamonds.

The principal manufacture of Constantinople is a kind of silk stuff, wefted with cotton twist, and brocaded with gold and silver flowers. It is generally made by Armenians, and is much used by the Turks for vests and under garments. In the city and its environs, it is computed that there are about ten thousand looms employed in the manufacture of this and other inferior articles.

Conflagrations. This city has frequently suffered from conflagrations, and its inhabitants have often been thinned by the more dreadful ravages of the plague. When a fire is once raised, it spreads with such rapidity, that whole streets

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are sometimes consumed before it can be extinguished. On its first appearance, the alarm is given by beating a great drum from two high towers; and the night-watch immediately patrole the streets, crying in a lamentable tone, *Yan-gun war!* "Fire, fire." The sultan is then summoned, and, when the conflagration has lasted an hour, is obliged to attend in person, and to distribute money among the firemen, who are very inactive until he arrives. The general method of stopping the flames is by pulling down the adjoining houses. But sometimes so rapid is the progress of the flames, that whole streets are in a blaze at once; and on such occasions numbers of the unfortunate inhabitants perish. Such is the constant apprehension of danger in which they live, that no one thinks of going to bed without some kind of outer garment; and the women commonly sleep with all their trinkets of value about them. It is also the custom of every family to keep their most precious effects in a little box, which is set upon the table every evening, that, in case of alarm, it may be hastily carried off; and when at any time the whole family goes out, it is always carried with them. In 1633, 70,000 houses were reduced to ashes; and in 1788 the conflagration was so extensive as to threaten the universal destruction of the city. The houses, however, are speedily rebuilt, and in the space of a month, scarcely any appearance of the calamity is left. It is believed that these conflagrations have been more frequently occasioned by intention than accident; and it is no uncommon circumstance for the Janissaries, when displeased with the Grand Vizier, to set fire to different parts of the city, and to repeat it until the minister is removed.

Plague.

The plague sometimes desolates Constantinople for years together; and from 1783 to 1785, it is said to have swept away about 100,000 children and young people. It is, however, very difficult to calculate the number that die of this disorder, for their want is scarcely perceived, there being such a constant influx of people from the country to the capital.

Police.

The police of Constantinople is equal to that of any city in the world; and such a strict watch is kept in every part of the city, that scarcely a malefactor can escape detection. The city guard consists of a body of Janissaries, with their colonel, to every gate of the city and the most frequented streets; and each of the streets have besides a party of two or three men. A continual patrole parades the city day and night. One hour after sunset all the gates are shut, and entrance strictly prohibited; and as soon as the last Muezzin has called the hour of evening prayer, every sober Mussulman retires to his home, and the streets become like a desert.

Population.

The population of Constantinople has been variously stated. Habesci makes it a million and a half, while Eton reduces it to less than 300,000! Dallaway calculates it at about 400,000, which is the most probable computation; and tells us, that according to the register of the Stamboul effendissy, or mayor of Constantinople, in the end of the last century, there were 88,185 houses, and 130 public baths. Of its inhabitants, scarcely one half are Turks, the rest are Greeks, Jews, Armenians and Franks. East Longitude of St Sophia's Church 28° 55′ 15″, North Lat. 41° 1′ 27″. See Dallaway's *Ancient and Modern Constantinople*, passim; Macgill's *Travels in Turkey*, &c. vol. i. p. 249; Habesci's *Ottoman Empire*, p. 354; Eton's *Survey of the Turkish Empire*, p. 281; Gibbon's *Roman Empire*, vol. iii. p. 1, &c.; Olivier's *Travels*, vol. i. p. 13, &c.; Clarke's *Travels*, part i. p. 688, and part ii. p. 1, &c.; Neibuhr's *Travels*, vol. i. p. 8; and Pouqueville's *Travels in the Ottoman Empire*, p. 240, &c. (*p*)

Constellation || Contract.

CONSTELLATION. See ASTRONOMY.

CONSUBSTANTIATION. See TRANSUBSTANTIATION.

CONSUL. See ROME.

CONSUMPTION. See MEDICINE.

CONTACT. See BOSCOVICH'S THEORY.

CONTAGION. See INFECTION.

CONTINUITY, LAW OF, is the name given by Leibnitz to a law, in virtue of which every thing that is done in nature is effected by infinitely small degrees. He maintains that *Natura non operatur per saltum,* and therefore that nothing can pass from one state to another, without passing through all the intermediate degrees. This law was slightly noticed by Galileo, but Leibnitz had the merit of adopting it as a leading principle in his philosophy. The argument by which he establishes the law of continuity appears to be conclusive. If a moving body receives an increment to its motion without the lapse of time, then the same body at the same instant is in two different states, which is absurd; and if the body receives the increment at the commencement of its motion, then the body must at the same instant be both at rest and in motion.

It is obvious, that when a ball is discharged from a cannon with a velocity of 1800 feet per second, it cannot be supposed to have acquired this velocity without the lapse of time. The ball must have had every assignable velocity from 0 to 1800 feet per second. In like manner, when a moving body changes its direction, it cannot move in the new direction without describing a portion of a curve, and moving in every possible direction between the one direction and the other. (*o*)

CONTRACT, in Law, is a voluntary agreement between two or more persons, whereby something is to be paid or performed by one of the contracting parties, for a valuable consideration to be given by the other. Contracts, from their nature, imply consent; and, therefore, those whom the law holds to be incapable of consent, as pupils, idiots, &c. cannot become parties to a contract.

The doctrine of contracts must necessarily occupy a considerable portion of the legal code of every civilized country; but the limits which our plan prescribes, will only permit us to exhibit a very short view of the several species of contracts, and to glance at the rules of law which are applicable to them.

By the Roman law, which, so far as regards this branch of jurisprudence, forms the basis of all modern systems, contracts were divided, according to the different modes in which they might be perfected, into *real, verbal, written,* and *consensual.* Real contracts were such as required that something should be actually paid or performed by one of the parties, before an obligation could be constituted against the other. Of this description were the four contracts of *loan, commodate, depositation,* and *pledge;* for the peculiar properties and effects of which we must refer to the civilians. See also the articles LOAN, HYPOTHEC, PAWN, and PLEDGE. The verbal contracts of the Romans, so far as they could be made effectual by action, were such as required to be perfected by certain *verba solennia,* or words of style. All other verbal agreements, in which this precise form was neglected, were considered as *nuda pacta,* on which no action lay. The written contract of the Romans, or *literarum obligatio,* as its designation implies, required the intervention of writing; in which the granter acknowledged the receipt of a sum of money, and bound himself to repay it to the creditor. Consensual contracts, according to the Roman law, were such as might be perfected by consent alone. Of this species were the contracts of SALE, LOCATION, SOCIETY, and MANDATE; for an account of which the reader is referred to those articles.

The writers on the law of Scotland have adopted the Roman division of contracts into *real*, *consensual*, and *written;* but, in the law of Scotland, there is nothing analogous to the *verborum obligatio* of the civilians; and therefore, as Mr Erskine observes, (*Inst.* b. iii. t. 2. § 1.) we may, without impropriety, apply the appellation of *verbal* to all such obligations, not requiring writing, as have no special name to distinguish them; and, contrary to the doctrine of the civil law, all such obligations will be effectual, provided no exception is made by positive institution. By the law of Scotland, writing is essential to all obligations or contracts relative to heritable rights, which are utterly ineffectual when merely verbal: (See DEED.) In Scotland also, there are certain contracts which require to be perfected in a peculiar form, and which will fall to be explained under their respective titles. See FEU *Contract*, MARRIAGE *Contract*, and COPARTNERY.

Contracts, according to the writers on the law of England, are either *express* or *implied.* Of the former description, are *debts*, *covenants*, and *promises.* Of the latter species, which in some degree resemble the *quasi contracts* of the Romans, are such as the law presumes that every man has contracted to perform. Among these may be reckoned, 1. The presumed contract or obligation, which every person is supposed to have come under, to pay such sums of money as are charged on him by the sentence of the law; and 2. All presumptive undertakings, which have been already explained under their proper title. See ASSUMPSIT. (*z*)

CONTRACTED VEIN, or *Vena contracta.* See HYDRODYNAMICS.

CONTUSION. See SURGERY.

CONVALLARIA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 188.

CONVENT. See MONASTERY.

CONVERGENCY OF MERIDIANS. See EARTH, and SURVEYING.

CONVEYANCE, in Law, is a deed or writing, by which property is conveyed, or transferred, from one person to another. See DEED.

Conveyances, according to the law of England, are either *original*, as FEOFFMENT, GIFT, GRANT, LEASE, EXCHANGE, and PARTITION; or *derivative*, as RELEASE, CONFIRMATION, ASSIGNMENT, and DEFEAZANCE. By the former, the benefit or estate is created; by the latter it is enlarged, restrained, transferred, or extinguished. (*z*)

CONVEYANCING, is the art of framing legal deeds or conveyances. This is an art, which necessarily presupposes a considerable progress in civilization; for as, in the rude state of society, possession can be the only certain evidence of property, so, previous to the use of writing, must its transmission be accompanied either with actual delivery, or with certain symbolical forms or ceremonies, indicating the surrender of the subject from the one party to the other. Among the Jews, we find the evidence of a purchase thus defined in the book of Ruth, (Ch. 4, v. 7.) "Now this was the manner in former time in Israel, concerning redeeming, and concerning changing, for to confirm all things; a man plucked off his shoe, and gave it to his neighbour, and this was a testimony in Israel." Among the ancient Goths and Swedes, contracts for the sale of lands were made in the presence of witnesses, who extended the cloak of the buyer, while the seller cast a clod of the land into it, as a symbol of the transference of possession; and a staff or wand was also delivered from the vender to the buyer, which passed through the hands of the witnesses. Among the Saxons, the delivery of a turf was a necessary solemnity, to render effectual the conveyance of lands. In England, to this day, the conveyance of copyhold estates is usually made from the seller to the lord, or his steward, by delivery of a rod or verge, and then from the lord to the purchaser, by re-delivery of the same in the presence of tenants. Many traces, indeed, of these symbolical forms of conveying property survived the introduction of written conveyances, and are still to be found among the legal customs of modern nations. But as the evidence of the mere delivery of possession, whether actual or symbolical, depended on the ocular testimony and remembrance of the witnesses, the conveyance must have been extremely liable to be forgotten or misrepresented, and must often, indeed, have become totally incapable of proof. Besides, in the progress of civilization and commerce, the new wants and necessities of men required means to be devised of charging and encumbering estates, without having recourse to an absolute sale or transference of the property; and similar devices were sometimes found convenient and useful, in order to enable a proprietor to make suitable provisions for the numerous branches of a family. These growing wants and necessities gradually gave rise to the various forms of written deeds and conveyances. Most of these forms sprung out of the Roman jurisprudence, and were thence transmitted to the ecclesiastical notaries; who, during the dark ages of Europe, which succeeded the fall of the Roman empire, were the sole depositaries of that species of learning. When a new dawn of civilization began to spread over the European horizon, and the rapid advancement of society and commerce multiplied the transactions of civil life, writing was again introduced into business; many of the ancient institutions were revived; and the legal language, and forms of the Romans, were drawn forth from the recesses of the church, and applied to the existing state of policy and manners. The feudal system, too, by diversifying the modes of conveying and of holding landed property, and introducing more intricate relations between proprietors and tenants, made the use of written documents an indispensable requisite; and the transmission of property has thus become infinitely more capable of evidence, and its possession consequently more secure.

If we consider the objects which the art of conveyancing has in view; the important relations of society which must depend upon the degrees of perfection to which it has been brought; and the intricate questions which we see every day arise, with regard to the validity, import, and construction of deeds; the study of this art will undoubtedly appear to be a matter of no little consequence. There are two objects of importance, to which the attention of the conveyancer ought to be especially directed; 1st, The form of the writing, which, in every species of deed, is fixed by practice, in so far as regards all the general or secondary clauses. 2d, The technical language in which those clauses are to be framed, which are intended to express the particular purposes for which the deed is granted. With a view to this object, it is of the most essential importance to the conveyancer, to have a clear, intimate, and precise knowledge of the meaning attached by the courts of law to particular terms, in order that he may be enabled, distinctly and effectually, to express the intention of the granter. The forms of legal deeds will come to be discussed in a future article. (z)

CONVOCATION, a representative assembly of the clergy of the English establishment, summoned to meet at the same time with parliament. It is called by a special writ from the king addressed to the archbishops, and requiring them to summon together all the bishops, deans, and archdeacons, with a certain number of proctors, or proxies, for the chapters and parochial clergy in their particular provinces. In that of York, there is only one house, but on account of the small number of dioceses under its archbishopric, each archdeaconry elects two representatives. The convocation of Canterbury, like the parliament, is divided into two houses, the upper and the lower; the former consisting of the bishops, with the archbishop as their president; and the lower, of 22 deans, 53 archdeacons, 24 prebendaries or proctors of chapters, 44 proctors for the diocesan clergy, and 1 precentor, viz. the precentor of the church of St David's, which has no dean. Each convocation has a prolocutor chosen by themselves, whose duty it is to secure the attendance of the members, to collect their votes, and, in the case of the lower house, to report their resolutions to the upper house. The archbishop prorogues and dissolves it by mandate from the king; and during its sittings, the members in attendance have the same privilege of freedom from arrest with members of parliament when on duty.

Till the reign of Henry VI., the inferior clergy appear to have regularly sat by representation in parliament; and previous to the Reformation, both houses frequently met in convocation, merely by authority of the archbishop's summons, without any writ from the king. At that time, they not only possessed but exercised the power of making ecclesiastical canons, which, so late as the 21st year of Henry VIII. were declared by parliament to be binding on the whole realm, when they related to matters within the jurisdiction of the church. Though, as ecclesiastics, they were exempted from regular taxation, yet they were in the custom of granting, from time to time, subsidies to government, under the name of *benevolences*, and, to enforce the collection of these, the censures of the church were employed when necessary. This right they continued to exercise till the time of Edward I. who inserted a new clause in the writs which were usually addresed to the archbishops, (denominated, from the first word, the *præmuniens* clause,) by which the members of convocation were required to be present with the king in parliament, for the purpose of consenting to the imposition of taxes, and all other matters that should come before them. Even after this, however, they enjoyed the right of taxing themselves, though, from the reign of Henry VIII. the subsidies which they voted were, in general, confirmed by act of parliament, in order to become effectual.

But having incurred the high displeasure of this monarch, and afraid of the dangerous consequences with which resistance to his measures or will might be attended, they in 1530 agreed to the celebrated *Act of Submission,* which two years afterwards was passed into a law, by which they renounced for ever all right to meet in convocation without the king's writ, or to enact, publish, or execute any new canons without his special assent and sanction,—a law to which they have ever since paid the most implicit subjection. Whether from having found the plan of taxing themselves attended with greater difficulty and trouble than they thought compensated by the mere possession of the right to do so, or from some other more powerful ecclesiastical or political reason, they also, in 1667, consented silently to wave their exercise of this privilege, and to allow themselves to be included in the money bills passed by the House of Commons. In the act by which this arrangement was legally established, there is a clause which still reserves their right; but since that period they have never attempted to revive it, and the only compensation for this which they received and enjoy, is the liberty of voting as electors for members of parliament.

From the time that this alteration of its prerogatives took place, the convocation has seldom met. At the close of the 17th century, indeed, a violent controversy was agitated, chiefly by Dr Atterbury on the one side, and Doctor afterwards Archbishop Wake on the other, concerning the rights and privileges of the convocation; but the unfairness and heat with which it was conducted on the part especially of the former, had no tendency to convince the public, that the resuscitation of the jurisdiction and energies of such an assembly would be in the least degree expedient; and the proceedings which subsequently took place in it, in the case of Dr Clarke in 1714, and at the commencement of the Bangorian controversy in 1717, were by no means calculated to induce ministry to wish that it should statedly meet for business. Accordingly, though it has been regularly called at the beginning of every new parliament, it has not since that time been permitted to enter on any business or discussion, but is generally prorogued from time to time, till it is dissolved along with the parliament. See Collier's *Ecclesiast. Hist.* Hody's *History of English Convocations*, Fuller's *Church History*, and Tindal's *Continuation of Rapin.* (d)

CONVOLVULUS, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, page 137, 173.

CONYZA, a genus of plants of the class Syngenesia, and order Polygamia Superflua. See BOTANY, page 298.

COOK, JAMES, whose talents and success as a circumnavigator and discoverer have been seldom equalled, but never surpassed, was born in the year 1728, at Marton, a small village in the North Riding of Yorkshire. His parents were in a very humble line of life, but of laudable and distinguished honesty and industry: his father was a day-labourer to a farmer in the neighbourhood, and resided in a small cottage, the walls of which were chiefly mud. Till the age of thirteen, the subject of this article was principally employed in assisting his father in various kinds of agricultural labour suited to his years, while, at his leisure hours, he was instructed by a school-master in a neighbouring village, in reading, writing, and a little arithmetic. At seventeen he was put apprentice to a shop-keeper at a populous fishing town, about ten miles from Whitby. This circumstance seems to have decided his future line of life: the sight and neighbourhood of the sea drew off his thoughts from the business for which he was designed, and planted in his breast a strong propensity to become a sailor. His master, who observed this, and who discovered in him more solidity of character, and steadiness of application, than are generally found at so early a period of life, agreed to discharge him from his indentures; and he soon after bound himself, for the term of three years, to Mr Walker of Whitby, who had several ships in the coal trade. During this period he served with great diligence, and much to the satisfaction of his new master; and when it was expired, he continued on board one of his ships, first as a common sailor, and afterwards as a mate. Mr Walker appears to have formed a due estimate of his character and his talents, and to have contributed all in his power to confirm and expand them. In order that his knowledge might be extended beyond what a mere seaman could acquire, he was employed in rigging and fitting out one of Mr Walker's ships: on board of this ship he made two coal voyages, and afterwards, when she was taken into the service of government as a transport, he proceeded in her to Middleburgh, Dublin, Liverpool, and Deptford, where she was paid off. He seems to have continued in the coal trade till the year 1753, when Mr Walker offered him the command of one of his vessels: this, however, he declined, and entered on board the Eagle frigate, "having a mind," as he expressed it, "to try his fortune that way."

No school of practical navigation is equal to that which the coal trade supplies, for drawing out, or forming, those qualities which characterise a good seaman; and it has generally been supposed that Captain Cook, in this school, learned those habits of composed and steady attention, of cool resolution, undaunted firmness, and unwearied perseverance, which distinguished him through life, and which were brought into exercise with so much advantage to himself, to his country, and to the cause of science, in his voyages round the world.

He had not been long on board the Eagle before he obtained from Mr Walker a letter of recommendation to the captain, which was of considerable service to him, and which he always spoke of with sentiments of gratitude. In 1759, in consequence of his character as an active and intelligent seaman, he obtained a warrant for the post of master; and soon afterwards sailed in the Mercury to assist in the reduction of Quebec. While he continued on this station, his abilities recommended him to the execution of a piece of service, which not only required considerable skill, but exposed him to no small danger: It was necessary, in carrying into effect the plan of the attack against Quebec, to take the soundings of the channel of the river St Lawrence, between the Isle of Orleans and the north shore, opposite the French encampment: this could be done only at night; but notwithstanding this circumstance, and the risk to which he was exposed, both from the French and the Indians, (by the latter of whom he was nearly taken,) he completed the undertaking in such a manner, that he was soon afterwards employed on one of a similar nature, but on a much larger scale. This was a chart of the river St Lawrence below Quebec, which he made with such minute and scrupulous accuracy, that no other survey has been found necessary. The distinguishing feature in Captain Cook's talents has generally been thought to be solidity rather than quickness; yet there is good reason to believe, that before this time he had never used a pencil in drawing: but difficulties may be overcome, as well by persevering solidity, as by rapidity of intellect; in the same manner as an opposing obstacle may be removed, either by the weight or celerity of the body employed for that purpose.

After the reduction of Quebec, Mr Cook was appointed master of the Northumberland, in which ship he continued at Halifax during the winter. As he had now a good deal of leisure, he employed it in obtaining a knowledge of those branches connected with his profession, which hitherto he had had no means of studying: Euclid and astronomy more particularly occupied his time. In 1762, the Northumberland was employed in the recapture of Newfoundland; and as soon as this was accomplished, Mr Cook surveyed the harbour and heights of Placentius with so much zeal, perseverance, and ability, as to attract the notice, and afterwards secure the esteem and friendship, of Captain Graves, the governor of Newfoundland. Towards the end of this year, Mr Cook returned to England, where he married an amiable woman, with whom that portion of his subsequent life, which was not devoted to the service of his country, was spent in a most affectionate and happy manner.

When the peace of Paris had secured Newfoundland to Great Britain, Captain Graves pointed out to government the value of that island, and the advantage which would result from making an accurate and complete survey of its coasts; after some demur, they sent out Captain Graves for this purpose, and he, knowing the abilities of Mr Cook, made proposals to him to go out along with him, to assist him in the execution of his plan. Accordingly he was first employed in the survey of the islands of St Pierre and Miquelon, which he finished in a month, and then returned to England: he soon, however, was induced to resume his situation and employment. Sir Hugh Palliser, (who became acquainted with him while he was on board the Eagle, and who ever afterwards patronized him,) was appointed governor of Labrador and Newfoundland; and Mr Cook accompanied him in the same capacity which he had held under Captain Graves: but he now appeared in an official and public character, being appointed marine surveyor of Newfoundland and Labrador; and in order that he might execute the duties of his office in the most complete and satisfactory manner, a schooner was placed under his direction. The aptitude and tendency of his mind to explore whatever was unknown in geography, induced him to go beyond the mere line of his duty; for he not only published charts of the coast of Newfoundland, which, like every thing else that he undertook, possessed all that accuracy which skill and experience, united to a conscientious discharge of whatever he was employed upon, could give them; but he also explored the interior parts of the island, and gained a more complete knowledge of them than had ever been acquired before. While he was in this situation, he had an opportunity of observing an eclipse of the sun, a short account of which he drew up and sent to the Royal Society. He continued marine surveyor of Newfoundland, (occasionally returning to England) till the year 1767, when he resigned the office, and took up his abode with his family.

Great Britain may deservedly boast of being the first country which undertook voyages of discovery for the purpose of enlarging the boundaries of human knowledge. The discoveries of the Spaniards and Portuguese, in the 15th century, were prompted and performed solely for the sake of commercial advantages; and the same motive and object gave rise to the discoveries of the English and Dutch at that era, and during the 16th century. Afterwards war united with commercial avarice in these undertakings, and when there remained no country undiscovered, from which wealth could be acquired, or by the conquest of which power could be extended, or ambition gratified, the spirit of discovery languished. Towards the close of the reign of Geo. II. it again revived, but it was of a superior and more honourable character: Those who planned the voyages of discovery sought not only to benefit enlightened and civilized society, by extending the boundaries of science and enlarging the knowledge of human nature, but also to improve the condition of savage life.

Soon after peace was restored in 1763, Captains Byron, Wallis, and Carteret, were sent out on a voyage round the world; and before the two latter had returned, it was resolved that another voyage of the same description should be undertaken. The principal and immediate object of this proposed voyage was the observation of a transit of Venus over the Sun's disk, which would happen in 1769; and as this transit would be seen to the greatest advantage in some part of the South Sea, thither the vessel employed was to proceed. At first, Alexander Dalrymple, Esq. a gentleman well known for his geographical and astronomical knowledge, which he had directed with great zeal, industry, and perseverance, to the elucidation of the various voyages which had been performed for the purpose of discovery in the Southern Ocean, was fixed upon to conduct the undertaking; but some obstacles arising from his insisting upon having the command of a king's ship to be appointed for the service, Mr Cook was recommended by Mr Stephens, the Secretary to the Admiralty, and by his tried friend Sir Hugh Palliser.

In consequence of the high character which they gave him, he was appointed to the command of the expedition, and promoted to the rank of a lieutenant in the royal navy. The choice of a proper vessel being left entirely to him, he fixed upon the Endeavour, of 370 tons, which had been formerly employed in the coal trade. Every precaution was taken, and every preparation made, which could most effectually and completely secure the accomplishment of the objects for which this voyage was planned. A sufficient number of seamen were appointed to the Endeavour; 10 carriage and 12 swivel guns were put on board her, together with an ample store of ammunition and other necessaries, and provisions for 18 months. Having thus fitted out the ship in the most proper manner for the purposes of a long voyage, the next object was to obtain the company and co-operation of such scientific men, as would reap from it every species of benefit to human knowledge, which it might be capable of affording. Mr Green, an assistant at the observatory of Greenwich, was associated with Captain Cook, to conduct the astronomical part of the voyage, and Mr (now Sir Joseph) Banks, together with Dr Solander, an eminent Swedish naturalist, offered their services for the extension of natural knowledge. The object of the intended voyage was not confined to the observation of the transit of Venus; Captain Cook was also directed to examine the Pacific Ocean with accuracy, and to extend the discoveries in that part of the world.

In this article, it would be improper and irrelevant to enter upon a detailed account of the circumstances of this and the subsequent voyages of Captain Cook; while, at the same time, it would be equally improper to omit the notice of them altogether; we shall therefore offer a general sketch of his voyages, touching only on those points in which his merit as a navigator, and his character as a man, are the most decidedly and conspicuously marked.

On the 26th of August 1768, the Endeavour sailed from Plymouth; and, on the 13th of April 1769, she anchored in Matavai bay in Otaheite: this island had been discovered, or at least explored, by Captain Wallis, and on his return, (which took place immediately before Captain Cook sailed,) he pointed it out as a proper place for observing the transit of Venus. Captain Cook had well digested the plan he meant to pursue with respect to the regulation of the intercourse between his crew and the natives; and, in conformity to this plan, he drew up a set of regulations before he suffered any of them to land at Otaheite: in these regulations he displays not only humanity and good sense, but a thorough insight into the character and feelings of a British seaman. His coolness, firmness, and forbearance, were however soon put to the proof, notwithstanding the clearness and propriety of the regulations which he had communicated to the crew: on the one hand, the natives were greatly addicted to pilfering, and on the other hand, the seamen, when robbed by them, had recourse to the most harsh and brutal modes of punishment, not only disproportionate to the crime, but of such a nature as would stimulate to revenge, rather than prevent the repetition of the injury. Partly, however, by the strictness of his discipline, and partly by the authority and respect which his impartiality, and spirit of conciliation, united to an unbending determination not to suffer himself to be materially imposed upon, procured him from the natives, he succeeded in protecting his crew from plunder, and the inhabitants from inadequate or unprofitable punishment.

The observation of the transit of Venus having taken place on the third of June, and every information that was curious, or could be useful, having been collected respecting the island, the Endeavour left it on the 13th of July. As there were several small islands adjacent to Otaheite, Captain Cook ascertained their relative situation, and gave to the whole groupe the general name of the Society Islands. On the 6th of October, having directed his course to the southward, he fell in with New Zealand. As this had been generally considered and represented as part of a supposed southern continent, Captain Cook resolved to examine it so completely, as should leave no doubt on this head. After much difficulty and labour, and no small degree of risque, he ascertained it to consist of two islands, separated from each other by a narrow strait. The inhabitants were in the lowest state of ignorance and barbarism, and he had not been long among them before it was proved, beyond a doubt, that they were real cannibals. The difficulty of preserving peace between the seamen and them, was still greater than Captain Cook had experienced at Otaheite; and it is not unreasonable to suppose, (a supposition which candour will readily admit,) that the strong and precipitate measures of violence towards the inhabitants of New Zealand, and which he found it absolutely necessary to employ, gained such an ascendency over the milder and more forbearing habits which he had displayed at Otaheite, as to keep them under, on subsequent occasions, when they would have been amply sufficient to have checked or conciliated the natives. On his departure from New Zealand, he steered to the west, and came in sight of New Holland on the 19th of April 1770. The eastern coast of this immense island was thoroughly explored, and it was a task which called for all the distinguishing qualities of Captain Cook's mind. On one occasion the Endeavour was exposed to great and imminent danger, in consequence of striking upon a hidden rock; the Captain and crew were surprised that she did not make much water, though even the shock itself must have damaged the vessel considerably; but their surprise was changed into pious gratitude, when, on their arrival at a port in New Holland, a piece of the broken rock was discovered sticking in the ship's bottom: to this circumstance alone they were indebted for their preservation. That part of the coast, which they explored, is particularly dangerous for the numerous shoals that lie off it; and to guard against these, to extricate the ship when she got entangled among them, required no common degree of nautical skill, and cool, steady, presence of mind. In the midst of these difficulties and dangers, Captain Cook not only participated in the labour and fatigues of his crew, but he also gave the impulse of his superior confidence and knowledge to those who were disposed to despair, or who were ignorant how to act. Hitherto the health of his ship's company had been good, owing principally to the care which Captain Cook took on this important point: he laid down plain and strict regulations with respect to cleanliness and ventilation, and he himself superintended and enforced adherence to these regulations. Whenever an opportunity occurred of procuring fresh meat or vegetables, they were always served out to the crew with the most scrupulous regard to impartiality; indeed he wisely, as well as humanely, gave the preference to the seamen, when the supply was inadequate, since their habits and mode of life exposed them more to diseases, and on their exertions principally depended the safety of the ship, and the accomplishment of the objects of the voyage.

The Endeavour left the coast of New Holland on the 23d of August. Captain Cook intended to have directed his course north west, till he had made the south coast of New Guinea, but in consequence of a shoal he met with, a few days after he left New Holland, on which the vessel was nearly lost, he altered his course. On the 3d of September New Guinea was in sight: a singular and unaccountable circumstance occurred here. As Captain Cook, in his boat, was observing the natives on the shore, they swung round them short pieces of stick, from which there immediately issued fire and smoke, exactly resembling those of a musket, and of as short a duration, but no report was heard. Captain Cook did not stay long off the coast of New Guinea, but during his stay, he established the fact beyond all controversy, that it is a distinct country from New Holland.

During his voyage from New Zealand to Batavia, Captain Cook had an opportunity of rectifying the errors of former navigators. In the latitude of 7° 6′ S. and the longitude 225° W. he discovered two islands, which either had no place in former charts, or if they were laid down in them, under the name of the Arrow islands, are placed at too great a distance from New Guinea. On the 7th of September, the Endeavour was in lat. 9° 30′ south, and in long. 229° 4′, where the Weasal isles are laid down in the older charts; but as no land was discovered, Captain Cook considered that this position of them was erroneous, though he was not able to ascertain it. Even when our navigator arrived at places which had been not only explored, but colonized by Europeans, one of his principal objects was to ascertain their latitude and longitude, and to compare the result of his own observations, with the existing charts, or the information he received from the inhabitants: in conformity with this rule, when he arrived at Savu, a Dutch settlement between Timor and Java, he compared the latitude and longitude which is given to it in the charts with his own observations: in many maps and charts, which he consulted, it was not laid down at all, and in none was it laid down accurately; he ascertained the middle of it to lie in the latitude of 10° 35′ south, and in the longitude of 237° 30′ west. We shall notice only one more proof of the minute and valuable accuracy of Captain Cook's investigation into every thing that could prove of service to navigation; as probably to this instance of it, we are indebted for the important settlement of Prince of Wales' island. This island had formerly been much frequented by the East India ships; but, on account of the supposed badness of its water, it was forsaken. Captain Cook remained at it 10 days, and ascertained that though the lower part of the brook, which supplies the water, is brackish, yet higher up its quality was excellent; he therefore strongly recommended this island as a staple place for the East India ships to touch at. At Batavia he lost many of his crew, and such was the fatal effect of that climate upon several others, that they died during his voyage from thence to England, where he arrived on the 12th of June 1771. The journals and papers of the captain and officers, and of Mr Banks, were put into the hands of Dr Hawksworth, who drew up an account of the voyage, more acceptable from its style, to the man of taste, than useful to the geographer, the seaman, or the natural historian, from the facts which it contains.

Although Captain Cook in this voyage had done away one of the arguments which had been brought forward for the existence of a southern continent, by having ascertained that New Holland, which had been supposed part of that continent, was in reality an island; yet many ingenious and well-informed men still adhered to this opinion; and the attention of the public was called, in a strong and peculiar manner, to the question, by Mr Dalrymple. Government, therefore, resolved to ascertain its existence, by sending out two vessels, for the express purpose of traversing every part of the Southern Ocean, where it could possibly lie. It was determined in this enterprize to send out two vessels, instead of a single one, as Captain Cook, in more instances than one, during his voyage, had been fearfully impressed with the danger to which the lives of himself and his crew, and consequently the object of the expedition, had been exposed, when every thing was committed to a single ship. Two vessels were accordingly purchased which had been built at Whitby, and which, like the Endeavour, were of that kind used in the coal trade; the larger, the command of which was given to Captain Cook, was named the Resolution; Captain Furneaux commanded the other, which was called the Adventure. No alteration was made in their mode of equipment, or in the nature of their stores or provisions, but such as the experience of Captain Cook suggested. That no opportunity of gaining information might be lost, Mr Hodges, a painter; Mr Reinhold Forster and his son, naturalists and philosophers; and Messrs Wales and Bayley, astronomers, were to accompany the expedition.

On the 13th of July 1772, the ships sailed from Plymouth; and before they reached the 51st degree of south latitude, they met with several ice islands. On the 17th of January 1773, they arrived in 67° 15′ south latitude, without having discovered any land. During this navigation, the crews suffered extremely from the intense cold; while, under this suffering, they were compelled to be constantly on the alert, and active, in order to avoid the danger from the ice with which they were encompassed. As in the track which they had pursued, Captain Cook had directed his course and examinations in such a manner, as to satisfy himself that no southern continent existed in this part of the ocean, Cook.

and as the winter was approaching, he directed his course northwards; soon after which, the ships parted by accident. On the 26th of March, the Resolution arrived in Dusky Bay, in New Zealand. As he had experience of the character of the natives, he took special care to guard against their pilfering disposition, and not to rouse their vindictive feelings; so that the intercourse of his crew with them was rendered uniformly friendly. Having thus removed all apprehension, both from his own mind and that of the natives, he not only explored the country, but enriched it with the productions of more fertile regions. From Dusky Bay, the Resolution proceeded to Queen Charlotte's Sound, where the Adventure had already arrived. Between the 7th of June and the 26th of November, the Society Isles, and the Isles of Magdeburg and Amsterdam, were visited, and New Zealand was still further explored. About the beginning of November the two ships were again separated, and did not rejoin during the remainder of the voyage. Soon after the separation, Captain Cook proceeded on a further search for the southern continent; but notwithstanding he varied his course, and traversed in every direction which he thought afforded the slightest chance of discovering land, and actually got as far south as the latitude of 71° 10′, he was unsuccessful. By this time the winter of 1774 had commenced in these regions; and the Resolution sailed for the Marquesas. After having ascertained the situation and relative bearings of these islands with great accuracy, Otaheite was visited for refreshments. But Captain Cook's activity and his impatience of ease, prompted him speedily to quit this island, and to go in search of some islands to the westward, which had been discovered by Quiras, and imperfectly described by Bougainville. The situation and extent of this archipelago were accurately and fully explored by our navigator, and to the whole groupe he gave the name of the New Hebrides. In proceeding from them to the south, in order to afford another chance for the discovery of a southern continent, he fell in with and examined a large island, to which he gave the Name of New Caledonia. Here great accessions were made to botanical knowledge, and a species of spruce pine was found, in great abundance, very proper for spars,—a discovery of great importance, as, excepting New Zealand, there was not an island in the South Pacific Ocean where a mast or yard could be procured. During their further progress to the south, Norfolk island was also discovered, on which there is now a flourishing English settlement. From this island the Resolution proceeded to New Zealand, where Captain Cook had the mortification to find, that the inhabitants had utterly neglected the gardens which he had formed there during his previous visit, and scarcely any of the animals that he had given them were now in existence.

On the 10th of November he left New Zealand, and having sailed till the 27th in different degrees of latitude, from 43° to 55° 48′ south, without discovering land, he steered due east for Terra del Fuego, which he reached on the 17th of December. Although this country offered nothing interesting, or that was likely to be useful to navigation, Captain Cook examined it thoroughly. Indeed, his conviction and idea of duty, as well as his natural disposition and acquired habits, would not permit him to leave any country unexplored. In the whole run across this ocean, in a higher southern latitude than had ever been attempted before, (except by the Adventure), though he was constantly upon the look out for every circumstance in the smallest degree material or interesting, he remarked, that he never had made a passage any where of such length, or even of a much shorter extent, in which so few things worthy of notice occurred.

After he had examined Terra del Fuego, he sailed round Cape Horn, and on the 17th January 1775, discovered a dreary and uninhabited island, to which he gave the name of Georgia. From it he proceeded as far as the 60th degree of south latitude, and in this course several small points of land were seen, none of which however bore the appearance of being parts of any extensive continent. Having thus most scrupulously and completely performed the object for which he was sent out, he directed his course homewards, steering to the south of the Cape of Good Hope, where land was said to have been discovered by the French. This, however, he searched for in vain; and after touching at the Cape, he pursued his voyage, and anchored at Spithead on the 30th of July 1775, having, in the space of three years and 18 days, sailed 20,000 leagues, mostly in an inhospitable climate, and unknown seas; and during the whole of this time he lost but four men, and only one of them by sickness.

Soon after his return, he was raised to the rank of post captain, and also appointed a captain in Greenwich Hospital. In the beginning of the year 1776, he was chosen a member of the Royal Society, on which occasion a paper of his was read, containing an account of the method which he had taken to preserve the health of the crew of the Resolution during her voyage round the world: for this paper the annual gold medal was unanimously adjudged him. Although this second voyage of Captain Cook is not so full of curious and interesting incidents as the first, and perhaps falls short of it in the importance of geographical and nautical discovery, yet in another point of view it was highly useful. Before this voyage, navigators, and even Captain Cook himself, were very ill-informed respecting the most easy and effectual mode of preserving the lives of seamen, where the changes of climate, frequent and rapid, the want of vegetables and fresh provisions, and the unavoidable confinement of a ship, add their destructive influence to the indolent and not very cleanly habits which distinguish this valuable class of men. Towards this object our navigator directed his most anxious and unremitted attention; and that he succeeded in accomplishing it, is sufficiently proved by the fact we have already noticed, that out of a crew of 118, only one died of sickness. In the paper which he submitted to the Royal Society, the means that he employed were clearly and fully detailed; they were simple, and depended for their efficacy as much upon the regularity and steadiness with which he enforced them, as upon their nature and quality. The character of the disorder, which generally attacks and carries off seamen during long voyages, sufficiently marks its cause: Before Captain Cook directed his thoughts to this important subject, a supply of fresh provisions and vegetables were regarded as the only means which could prevent or remove the attacks of the scurvy; but as, notwithstanding the use of these means, the deaths on long voyages were very numerous, Captain Cook took other measures. As this disorder proceeds from or produces debility, he was constantly attentive to protect his men from cold, wet, and over-fatigue: he also frequently aired and fumigated his ship; but, above all things, he particularly enjoined cleanliness and exercise. The merit of Captain Cook in these regulations, is sufficiently evident from this circumstance, that since they were known to be so completely efficacious in his voyages, and since they were so amply and clearly detailed in his paper, the mortality in the longest voyages is scarcely proportionally greater than it is on shore.

In consequence of the objections which had been made to Dr Hawksworth's edition of the first voyage, Captain Cook undertook the publication of the second; and the manner in which it is written is extremely proper for the subject, and therefore highly creditable to himself: The stile is that of his own character, simple, clear, and manly, looking more to what is useful than what is ornamental.

The existence of a southern continent being now banished from the belief of most people, at all capable of forming an opinion upon the subject, only one disputed point of nautical geography, of any magnitude or importance, remained to be settled; and that was the existence or practicability of a communication between the Atlantic and Pacific Oceans, by a high northern latitude. Could an easy and safe communication be discovered, it would greatly shorten the passage between the eastern and western continents; that it did exist, many eminent geographers were of opinion, and to this opinion they were led by the appearance of the coast on the east side of North America: the deep and extensive bays there seemed to promise a communication with the Pacific Ocean; and if the coast on the north-west of this continent were explored, they expressed their belief, that the desired object would be accomplished. The British government, therefore, resolved to explore both the eastern and western coasts; to the former, Lieutenant Pickersgill was sent out in 1776, and, in the subsequent year, Lieutenant Young. But the most important and arduous undertaking was, the examination of the western coast of America: of it very little was known. Government, when they had formed the plan of these new voyages of discovery, naturally looked to Captain Cook to undertake the principal part in them; but as he had already done so much for his country, and the extension of geographical and nautical knowledge, they hesitated about making a direct proposal to him on the subject. It was, however, only necessary to mention, apparently incidentally, the importance of the scheme in his presence: he immediately entered into it with the utmost zeal, and voluntarily offered to undertake the execution of it. The Resolution, and another vessel called the Discovery, were prepared for the voyage, with as little delay as possible. Captain Cook took the command of the first, and Captain Clarke of the other. The equipment was similar to that of the second voyage, except that the department of natural history was entrusted to Mr Anderson, the surgeon of the Resolution.

On the 12th of July 1776, the Resolution sailed from Plymouth; the Discovery, not being ready, did not sail till a short time afterwards. The two ships joined at the Cape, which they left about the end of November; and after having visited New Zealand and the Friendly Isles, with the productions and inhabitants of which they gained a more accurate and extensive acquaintance, and having discovered a numerous groupe of inhabited islands in north latitude 21°, to whom Captain Cook gave the name of the Sandwich Islands, they proceeded to the western coast of North America, which they reached on the 7th of March 1778. At Nootka Sound, in latitude 49° 33′ N. they repaired their ships, previously to entering upon the primary and most important object of their voyage. Thence, to the north, they examined the coast with great care: wherever there was the slightest appearance of an inlet or large river, Captain Cook either went himself, or sent such officers as he could trust, to explore it; and though many difficulties occurred, and there existed no chart or journal of a previous voyage to direct his examination, or rectify any mistake into which he might have fallen, yet only in one case does he appear to have formed an erroneous opinion. Captain Vancouver has since proved, that what Captain Cook supposed was a river, (and to which his own name was given,) is only an inlet of no great extent or importance. During this part of the voyage, the coasts of Asia, as well as those of America, were examined; and in the comparatively short space of time which was spent on this examination, Captain Cook obtained a more correct and full knowledge of them than the Russians had procured, notwithstanding they had many settlements here, and several vessels had been employed for the purpose of exploring the adjacent coasts. As the winter was approaching, he now resolved to direct his course to the south, after having examined the western coast of America from the latitude of 43° to 70° north, containing an extent of 3500 miles; "ascertained the proximity of the two great continents of Asia and America; passed the straits between them, and surveyed the coasts on each side to such a height of northern latitude, as to demonstrate the impracticability of a passage in that hemisphere, from the Atlantic into the Pacific Ocean, either by an eastern or a western course."

On the 26th of November, the Resolution and Discovery arrived at the Sandwich Islands, which Captain Cook surveyed with more care and accuracy, than his time would permit when he visited them before. In the course of this survey, Owhyhee was discovered, the largest and most important of the whole groupe. As it was now absolutely necessary to refit the ships, and prepare them for a return to a high northern latitude, his first object was to find out a proper bay for this purpose in Owhyhee; after due examination, a bay named Karakakooa was fixed upon. In the course of this visit to the Sandwich Islands, the character and talents of the natives particularly struck and interested Captain Cook; in the former, there was a greater degree of openness than he had witnessed among the inhabitants of the other islands which he had visited; they supplied his wants with great cheerfulness and liberality, while their merit was superior, in this respect, to that of other savages, as they seemed to possess more accurate ideas of property. With regard to their talents, they were naturally good, uniting a considerable degree of quickness, with more steadiness of application, than the inhabitants of Otaheite displayed. When Captain Cook visited them, they had already made no small advance in several of the arts of life; and they manifested an earnest and actuating desire to improve their useful knowledge, by the instructions and example of the British.

This cast of character and talents led them to receive and treat Captain Cook with great attention and respect; in their opinion he appeared to belong to a superior race of beings. Having completed the purposes of his visit, he left Owhyhee on the 4th of February 1779; but a few days afterwards, the Resolution having sprung her foremast, both the ships returned to Karakakooa. The disposition and conduct of the natives towards them were different from what it had been; there was less cordiality and frankness, and a stronger and more systematic tendency to pilfer. Captain Cook could not account for this change; it mortified him extremely to perceive himself under the necessity of guarding against, and punishing, the thefts of those, of whose character he had formed such an high opinion. He soon found, however, that the utmost strictness and severity were absolutely indispensible, if he wished the ships and crew to be preserved from utter plunder; every day the natives stole something, and even when they were detected and punished, their thefts became more insolent and daring; at last they seized upon, and carried off a large cutter belonging to the Resolution. The most decisive and strong measures were adopted by Captain Cook; he ordered two boats to intercept the canoes which should endeavour to leave the bay, and, if necessary, to fire upon them. On all similar occasions, one of his first objects was to seize the person of the king or chief. This plan he determined to follow now, and for that purpose he went on shore himself with an armed force. Notwithstanding the change in the disposition and behaviour of the natives, the reason they knew they had given for the anger of the English, and the suspicion and alarm which the armed men must have excited, they received him with their accustomed respect; but this was completely destroyed as soon as they perceived that their king was a prisoner. Every thing now bore the appearance of the most angry and determined hostility; a crowd gathered round Captain Cook, and made use of the most menacing gestures; as he persevered in detaining the king, and in carrying him on board the Resolution, others of the natives ran for their arms. In this critical situation, the men who were left in the boat fired upon and killed one of the chiefs; as soon as this was known, the crowd round Captain Cook increased in numbers and in violence, and such an implacable spirit was shewn, that he thought it prudent to liberate the king, and turn his whole thoughts to the safety of himself and his men. But it was now too late; many of the natives did not perceive that their king was liberated, and the anger and desire of revenge in those who did, was roused too high to be allayed by this measure, which they probably ascribed solely to fear and compulsion. Captain Cook pushed forward towards the shore, off which a boat was lying to protect him, and receive him on board; every minute his situation became more alarming; his progress was impeded by the crowd; stones were thrown—the marines fired—the savages rushed upon them, and nearly overwhelmed them. The strength of Captain Cook by this time was nearly exhausted by pushing through the crowd, and protecting himself from their attacks; he might, however, probably have escaped, had not the boat in waiting drawn farther off. Even in this crisis of personal peril, he was more anxious for the safety of his men than of himself; they all got on board, he alone remained on the shore; the blow of a club staggered him; he fell on one knee, and as he was rising, a stab was given him; he fell again into the water, and after struggling for some time with the savages, who held him down, he was dispatched by a blow with a club. As soon as he was dead, all were eager to plunge their daggers into his body; and after they had thus glutted their revenge, they carried it off in triumph. Captain Clarke, who succeeded to the command of the expedition, made every effort to recover the remains of Captain Cook; but only his bones were obtained, and these were committed to the deep amidst the heart-felt grief of all those who had served with him.

Captain Cook was above the common size; his countenance was expressive, but rather austere. His manners were plain, simple, and manly. His natural disposition, and the habits of his professional life, rather inclined him to be peremptory and hasty; but his good sense, his knowledge of mankind, and above all his humanity and benevolence, soon bore down this tendency. His talents were of the most useful kind; he saw clearly and deeply into whatever interested him; and his designs were accordingly bold and extensive. When these were formed, he expressed no doubt about their execution, for the same perspicuity and orderly arrangement of thought which enabled him to form the designs, also enabled him to devise the most simple and effectual mode of executing them. In the execution he was equally distinguished; no difficulty perplexed him, no danger appalled him; the talents and knowledge he possessed were always completely at his command, when they were most needed; and, for great designs, he was also qualified by the constitution of his body, which was robust, inured to labour, and capable of supporting the greatest fatigue and hardships. No food, however coarse, was ungrateful to his palate, or unacceptable to his stomach.

As a navigator, he was of the highest order, whether we contemplate the discoveries he made, or the means by which they were accomplished. That England did not partially overrate his merits, was abundantly and most unequivocally testified, by the honours which were bestowed upon his memory by foreign nations.

Captain Cook left a widow and three sons, upon whom pensions were settled. The sons were brought up in the service of their country; one of them was lost at sea, and the other two fell honourably in her cause. See Kippis' *Life of Cook*. (W. S.)

COOKERY. See ALIMENTS.

COOKIA, a genus of plants of the class Diandria, and order Monogynia. See BOTANY, p. 211.

COOLING. See ALCARAZZAS, CHEMISTRY, p. 33, 34, COLD, and HEAT.

COOPER, ANTHONY ASHLEY, first earl of Shaftesbury, was one of the most prominent characters among the English politicians of the seventeenth century. He was born in 1621, in Dorsetshire. His father was a baronet; and young Anthony, being an only son, inherited, along with the title, a large landed property, said to amount to L. 8000 a-year; an extraordinary sum in these days. After receiving the rudiments of education at home, he was sent, at fifteen, to Oxford, and afterwards to Lincoln's Inn. His education seems to have been very well conducted, and his mind directed to serious study, at an age when inheritors of fortune cannot, in general, be withheld from a very different course. He was returned a member of parliament so early as 1640, when only in his nineteenth year. A few years afterwards, we find him taking part with the king in the civil war, and venturing, according to Mr Locke, to recommend to Charles to grant the commons a redress of their grievances, as the only effectual method of terminating the war. "I entreat your majesty," he said to the king at Oxford, "to empower me to treat with the parliament garrisons; to grant them an assurance that, arms being laid down on both sides, a general amnesty shall reinstate all things in the posture they were in before the war, and that a free parliament shall do what remains to be done for the settlement of the nation." The king, it is believed, authorised him to try the experiment in his own county; and he appears to have obtained possession of Weymouth, at that time a garrisoned town, on an understanding of the above nature. Prince Maurice, however, having troops in the neighbourhood, entered Weymouth, and permitted his soldiers to live at free quarters on the inhabitants. Sir Anthony remonstrated warmly against this infraction of his promise; but finding representations ineffectual, he broke off a pending negotiation with the towns of Poole and Dorchester, apprising them that he could not be responsible for the fulfilment of the promised conditions. The king, preferring the counsels of his old adherents to the propositions of so young a person as Sir Anthony, the latter was induced, as some say, by a consideration of safety, but more probably by offended pride, to change sides, and connect himself with parliament. His disposition rendering him ardent in whatever he espoused, he soon accepted a commission from parliament, and raised forces in Dorsetshire to combat the royal cause; but, notwithstanding his activity in the field, he is said to have been regarded by the Court among the least rancorous of their opponents.

Sir Anthony appears to have taken no part in the proceedings connected with the trial of Charles. When Cromwell began to throw off the mask, and to appropriate to himself the power of which he had stripped his sovereign, Shaftesbury had the courage to join a few spirited men in opposing his usurpation; although Cromwell sought to gain him, along with other persons of consequence, by appointing them members of his privy council. After the Protector's death, Sir Anthony was suspected to be in correspondence with the royalists. Appearances were strongly against him, but he had the address to obtain an acquittal of the charge. He next aimed at the same result by indirect means, engaging Monk to march southward with his army, and taking an active part in detaching Vice-admiral Lawson, who commanded the fleet, from the cause of the commonwealth. The Restoration being accomplished, Sir Anthony became a member of the privy council, and was raised to the peerage by the title of Baron Ashley. He is said to have owed his first appointments at court to the influence of the Earl of Southamptom, to whose family he was related by marriage. After being for some time chancellor of the exchequer, he became one of the lords commissioners of the treasury, and lord-lieutenant of the county of Dorset. In April 1672 he was created Earl of Shaftesbury, and, towards the end of the year, invested with the high post of chancellor of England. It is singular enough that Shaftesbury, doubtful as his character was in most respects, is allowed to have acquitted himself with equal honour and ability in the capacity of a judge. He laboured to abridge the delays of process as much as possible; and though he failed in persuading the lawyers to relinquish their circuitous forms, he succeeded, by his habits of attention and decision, in clearing a great part of the arrears of that court.

Of his proceedings in a political character, a very different opinion is entertained. Though he does not appear to have been privy to all the conditions of Charles' disgraceful treaty with France, he had a principal hand in giving effect to the Dutch war—to the projects relative to a change of religion—and to the exercise of a corrupt influence in the election of members of parliament. The shutting up the exchequer, the boldest, perhaps, of all the measures of this shameless reign, is now considered to have been less the act of Shaftesbury, than of his iniquitous coadjutor in office Clifford. At last, in 1673, the tide of popular opinion running very strongly against the French alliance, and Charles being disappointed in his dream of a golden harvest from Dutch captures, Shaftesbury determined not to remain so long with the court, as to lose the alternative of gaining favour with the people. Charles was hard pressed by parliament to cancel the obnoxious declaration of indulgence, in regard to liberty of conscience; a declaration which, from its partiality to Catholics and Protestant dissenters, had given great alarm to the church. Shaftesbury, and his brother members of the cabal, strongly dissuaded the king from complying; but Charles disregarded their arguments, and made, in parliament, a public renunciation of the act. Shaftesbury now saw that the king had secret views, and that a minister was unsafe in encountering public odium in his service. He therefore took his measures, not merely for withdrawing from court, but for assuming a lead in the opposition. The ostensible ground which he took, was that of resistance to the Duke of York's succession to the crown, and of alarm for the Protestant religion.

We are now arrived at the epoch in Shaftesbury's life, when he became definitively the opponent of the Court. As leader of the opposition, he discovered perhaps more talent and exertion than in any former situation. His usual residence was in London, towards the interior of the city, where his popularity became extremely great. The long parliament having re-assembled in February 1677, after a recess of fifteen months, Shaftesbury argued that it ought to be considered as dissolved. This opinion he asserted with so much warmth, that the court thought proper to commit him and three other peers to the Tower. His fellow prisoners were not slow in making their submission, and obtaining a discharge; but Shaftesbury at first took higher ground, and brought his case before the Court of King's Bench. Being, however, remanded to the Tower, and becoming anxious to resume his station in the ranks of opposition, he made a virtue of necessity, and, on declaring his submission, was restored to liberty. He now came forward as a powerful opponent of the Earl of Danby's administration. A change becoming indispensible, the king professed to adopt the advice of Sir William Temple, and to call to his privy council the most distinguished men in public life in the kingdom. When all was on the eve of being settled, and Sir William, with his friends, were making the definitive arrangements, the king inserted the name of Shaftesbury as lord president of the council, and made a jest of all Sir William's objections to this unexpected nomination. Had Sir William been of a suspicious disposition, he would have discovered, that this act of Charles was nothing more than a part of the dissimulation which he had carried on throughout the whole proceedings for the arrangement in question. Shaftesbury retained his station of lord president from April to October 1679; but finding that, without possessing influence over the measures of the court, he was in danger of ruining his popularity, he took the determination to withdraw from all official employment.

The year 1678 was the æra of that mysterious intrigue, the Popish plot. Shaftesbury having seized with avidity this favourable opportunity of shaking the power of the Duke of York, and having pursued the parties accused with unrelenting severity, has got credit for being the author of the whole conspiracy. Sir John Dalrymple goes so far as to allege, that papers which he had seen convinced him that Shaftesbury was the contriver of it, though the persons he made use of as informers ran beyond their instructions. Sir John adds a story of Shaftesbury, saying, when pressed in regard to the absurdity of the circumstances, "It is no matter; the more nonsensical the better: if we cannot bring them to swallow worse nonsense than that, we shall never do any good with them." It is to be regretted that Sir John's judgment in forming conclusions from public documents was far inferior to his industry in procuring them. Shaftesbury was not likely to use such words as these in company with a person capable of reporting them; and it is much more probable that he turned the circumstances of the plot to account, than that he was the inventor of it. His persevering activity on this occasion, his ardent support of the Exclusion Bill, and his subsequent protest against the return of the Duke of York from abroad, rendered the latter his implacable enemy.

Shaftesbury continued at the head of the opposition so long as there was a parliament. In 1681, Charles having come to the determination of finally dispensing with these troublesome assemblies, retrenched his expences, published an appeal to the people on the conduct of parliament, and renewed, in secret, his treaty with France. By this time the circumstances of the Popish plot began to be discredited, and the court ventured to proceed against the leading members of opposition. The aged Earl of Stafford was tried and brought to the block. Shaftesbury was apprehended, examined before the Privy Council, and committed to the Tower. Here he remained more than four months, and was brought to trial towards the end of the year. The witnesses brought forward against him were of bad character; but a paper found in his study, and containing the draught of an association, was made the subject of a very serious charge. As it was not however in his hand-writing, and contained nothing treasonable in regard to the person of the sovereign, the grand jury thought proper to discharge Shaftesbury. His Lordship, when released, assumed a bold tone, and brought an action against a person who, in conversation, had attributed to him traitorous designs. Such was Shaftesbury's popularity, in the metropolis, that the defendant resorted to the unusual expedient of moving for a trial out of Middlesex, on which the suit was dropped.

The fiction of the Popish plot was succeeded in 1682 by a real conspiracy, known by the name of the Rye-House Plot. Lord Russel, Lord Essex, Algernon Sidney, and other leaders of opposition, being debarred from the means of making a constitutional resistance in parliament, resorted to the equivocal course of secret combination. Though they disliked Shaftesbury's character, and still more the prospect of his assuming an ascendancy among them, they felt their need of his powerful and daring party in the city, and did not hesitate to make him completely privy to their schemes. Shaftesbury, taught by long experience, the expediency of prompt exertion when engaged in so hazardous a scheme as the overthrow of the executive power, was for losing no time in striking a blow. Michaelmas (1682) was first proposed as the time of insurrection, but it was delayed month after month. Shaftesbury, distrusting the judgment of the conspirators, and out of patience with their reiterated delays, thought it expedient to withdraw from the power of his enemies.

In November (1682) he crossed over to Holland, and took a house at Amsterdam. Here, however, his active career was soon brought to a close. The gout, to which he had long been subject, returned with redoubled violence, and attacking his stomach, put an end to his life in January 1683, in the 62d year of his age.

No character in the English history has been more the subject of controversy than that of Shaftesbury. Though the majority of writers are disposed to condemn him in very strong terms. The exculpatory efforts of Mr Locke, and the discovery of his innocence in two or three very suspicious transactions, have tended to abate, in some measure, the current of general odium. There are, it is understood, in the possession of the Shaftesbury family, various documents explanatory of his conduct, and calculated, it is said, to mitigate the severity of public censure. These documents have been confided, with a view to publication, to several persons, none of whom have discharged the task. Our limits do not permit us to enter on an analysis of the character of this extraordinary man, and we regret it the less, as a biographical account of him may, we understand, be ere long expected. The brightest part of his conduct was an exemption from the influence of avarice, a very prevalent vice among the ministers of that age. Hence his unimpeached integrity in the administration of justice. But how different must be our opinion of his political proceedings, whether we regard him as a member of that cabal which aimed at the overthrow of the constitution, or as the leader of a popular party, prosecuting the victims of a plot which he must have known to be fictitious. His temper was violent; his disposition restless; but, on the other hand, he was indefatigable in business, and impressive in public speaking. Unfortunately he did not scruple to set at work the worst passions of mankind for the promotion of his ambition, and his repeated changes from the court to the people, deprive his character of all claim to the influence of public principles. We conclude this article by transcribing one of the latest opinions expressed in regard to Shaftesbury. It is contained in a letter from Mr Fox to his friend, Sergeant Heywood, and forms the last document in the preface to the *History of the early part of the Reign of James II.*

"I am quite glad I have little to do with Shaftesbury; for as to making him a real patriot, or friend to our ideas of liberty, it is impossible, at least in my opinion. On the other hand, he is very far from being the devil he is described. Indeed, he seems to have been strictly a man of honour, if that praise can be given to one destitute of *public* virtue, and who did not consider Catholics as fellow-creatures; a feeling very common in those times. Locke was probably caught by his splendid qualities, his courage, his openness, his party zeal, his eloquence, his fair dealing with his friends, and his superiority to vulgar corruption. Locke's partiality might make him, on the other hand, blind to the indifference with which he (Shaftesbury) espoused either monarchical, arbitrary, or republican principles, as best suited his ambition; but could it make him blind to the relentless cruelty with which he persecuted the Papists in the affair of the Popish plot, merely, as it should seem, because it suited the purposes of the party with which he was then engaged? You know that some of the imputations against him are certainly false; the shutting up the Exchequer, for instance. But the two great blots of sitting on the Regicides, and his conduct in the Popish plot, can never be wiped off. The second Dutch war is a bad business, in which he engaged heartily, and in which (notwithstanding all his apologists say,) he would have persevered, if he had not found the king was cheating him." (χ)

COOPER, Anthony Ashley, grandson of the preceding, and third Earl of Shaftesbury, was born in 1671. Literature was the object of his pursuit, as political aggrandisement had been that of his grandfather. The latter, desirous to familiarise his descendant with the learned languages from his earliest years, placed him under the charge of a schoolmaster's daughter, accustomed to speak Greek and Latin with fluency. He was thus enabled to read passages of authors in either language at the early age of eleven. At fifteen he began his travels, and passed three years on the Continent. Returning to England, he had the good sense to decline accepting a seat in the House of Commons during five years, and made a scrupulous appropriation of his time to study. It is related that, soon after taking his seat, he rose to speak on a bill, brought in for the regulation of trials for high treason. It had been proposed to refuse counsel to prisoners in this predicament; a measure which Lord Ashley regarded as tyrannical, and was determined to oppose. He had carefully prepared his speech; but on standing up to deliver it, he was so awed by the presence of the assembly, as to feel himself unable to proceed. The house, however, encouraging him, he recollected himself so far as to give a very happy turn to his confusion. "If I, who rise only to give my opinion on the bill now depending, am so confounded, what must the condition of that man be, who, without any assistance, is pleading for his life?" The effect on the house of this well-timed appeal was very favourable, and Lord Ashley continued a zealous supporter of the cause of liberty. But his feeble health was unequal to the fatigue of regular attendance in parliament, and his inclination led him to prefer literary retirement. His father dying in 1699, the young lord gave his interest to the ministry, who were then engaged in supporting King William's plans for a new alliance against Louis XIV. It is said that King William declared, that Lord Shaftesbury's interest had turned the balance in favour of ministers, in the election of the new parliament; and it is added, that he made him an offer of the secretaryship of state.

On the demise of King William, the government passing into the hands of other ministers, Lord Shaftesbury forsook the court, and returned to his literary occupations. Holland being at that time the residence of Bayle, Le Clerc, and other free enquirers, his Lordship diversified his retirement by an occasional visit to that quarter. Some years afterwards, in 1708 and 1709, he began to publish. His first works were, a Letter on Enthusiasm; the Moralist; a Philosophical Rhapsody; and *Sensus Communis*, an essay on the freedom of wit and humour. At this time also he became a married man, less it appears from the influence of love or ambition, than to comply with the solicitation of those, who, to use his own words, "thought the family worth preserving." In 1710, appeared his well-known Soliloquy, or Advice to an Author, a work evidently superior to his preceding publications. But his health was now in such a state of decline, as to require a change of climate. Notwithstanding the war, he obtained leave to travel through France, and proceeded to Naples, where, after residing a year and a half, he died in 1713, at the early age of forty-two. The last part of his career was employed in finishing a corrected edition of his great work, the Characteristics. It came out soon after his death, and the prints first published with the work were invented by him, and designed under his personal inspection. Publications of parts of his correspondence took place in succeeding years; first in 1716, under the title of, Letters from a noble Lord to a young man at the University; and in 1721, under the title of, Letters from the late Earl of Shaftesbury to Lord Molesworth.

The advantage of an early familiarity with the ancient languages, was strongly exemplified in the course of his Lordship's studies. Though well acquainted with the eminent writers in his own language, his favourite occupation was the perusal of the authors of Greece and Rome. The moral works of Xenophon, Horace, and Epictetus, were so acceptable to him, that he made a rule to carry copies of them in his various excursions. These copies are still extant in the family library, and the number of his marginal notes bears ample testimony to his zeal and industry. Happy had it been if his Lordship had been content to build his fame on the extent of his classical attainments and knowledge of morals, without coveting distinction, by professing scepticism in regard to the Christian religion. We regret this the more, as Lord Shaftesbury's character, like Mr Hume's, was marked by many valuable qualities. "He was," says Warburton, "temperate, honest, and a lover of his country." His pretensions to great literary distinction, however, are more doubtful than his title to the praise of honour and patriotism. The high polish of his style, and the sentimental vein of his philosophy, procured him, for many years, a great reputation; but acute scholars, such as Dr Jortin and Mr Gray, did not hesitate to express a very different opinion. A later author, however, Lord Monboddo, extols Lord Shaftesbury to the skies, equally on the ground of composition and of philosophy. To enter into an elaborate disquisition of this subject would much exceed our limits; and we are spared the trouble, by being enabled to appeal to an opinion from a high quarter, which has probably engaged, long ago, the attention of most of our readers; we mean, Dr Blair's judgment of Shaftesbury, in the Lectures on Rhetoric and Belles Lettres. That eminent critic bestows much praise on the skilful and elegant construction of his Lordship's language, while he passes a merited censure on that stiffness and fastidiousness, which prevented him from expressing any thing with simplicity, and which led him into perpetual circumlocutions. His Lordship left one son, who became the fourth Earl of Shaftesbury. (χ)

COPAIFERA, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 219.

COPAL. See Chemistry, p. 123, and Varnish.

COPENHAGEN, originally *Kiobmandshavn*, "the merchant's harbour," the capital of Denmark, is situated on a small promontory on the eastern coast of the isle of Zealand, in North Lat. 55° 41′ 4″, and East Long. 12° 34′ 15″. It is fortified towards the land with regular ramparts and bastions, and environed with a wet ditch, which is both broad and deep. On the sea side its principal defence is the Crown battery, which is about half an English mile from the shore. It is built in the form of a square; the water flows into the middle of it; and, since the battle of Copenhagen, it has been greatly strengthened and enlarged. The citadel, which stands at the north-east extremity of the town, is but small, containing two battalions, and its only gate is fortified with five bastions.

Copenhagen, though of no great extent, is one of the handsomest cities in the north of Europe. It is between four and five miles in circumference, and consists of the old and new town, and Christianshafen. The streets are, in general, broad and well paved, with a foot path on each side, but sometimes very narrow and inconvenient; and some of them are intersected by canals, which afford a great facility to the transportation of goods. The Rue de Goths, and Amalien Gade, in particular, are beautiful streets, and the former is about three quarters of an English mile in length. There is a peculiarity in the mode of building in this city, which is mentioned by Mr M'Donald, and which is indeed a very judicious and convenient one in a crowded city. "Instead of the usual right angles," says he, "formed by the corners of the houses at the extremities or divisions of the streets, the builders of Copenhagen have squared them off in a semi-octangular form, and thereby secured various advantages. Carriages and horses cannot so frequently run foul of each other, or run down persons on foot at the turnings of the streets; the space gained gives a free circulation of air, and the look of as many handsome squares as there are street divisions in the city." Most of the houses are modern, and are built of brick, sometimes stuccoed to resemble stone, which exhibit a beautiful and uniform appearance; and a few of them are constructed of freestone brought from Germany. They are, in general, spacious, having four complete stories, besides sunk cellars and garrets; and those of the nobility in particular are splendid, and elegantly finished in the Italian style of architecture. The shops are as usual confined to the ground story, but as they make no prominent appearance as in most of our cities, they do not disfigure the rest of the building.

Old Copenhagen occupies the western division of the city north of the harbour, and contains the principal public buildings. The palace of Christiansburg, which was destroyed by the conflagration of 1794, and whose ruins still bear testimony to its former magnificence, was erected by Christian VI. out of his own private purse, and is said to have cost six millions of dollars. Its size is out of all proportion either to the extent or the resources of the kingdom; and were we not satisfied of the prudent and paternal administration of its founder, we might have suspected, that it had its origin either in his prodigality or his pride. The front, which is constructed of stone, is 367 feet long, and the lateral sides, built of brick stuccoed, are 389. The elevation is 114 feet, with six stories, of which three are upon a large, and the remaining three upon a smaller scale. The principal suite of apartments is in the fourth story, and the interior decorations were equal to its external grandeur; but so sudden and rapid was the conflagration, that very little of its furniture, pictures, &c. were preserved. The *Ritta saal*, or knight's saloon, was particularly splendid. It was 118 feet by 58, with a gallery on each side richly gilded, and supported by 44 columns of cinnamon wood; and lighted at night by three lustres, which contained more than 1200 wax lights. One of the wings, to which the flames did not extend, still contains the royal museum, or cabinet of rarities, which is ranged in eight apartments in the following order: animals; shells; minerals; paintings; antiquities; medals; dresses, and arms and implements of the Laplanders; and is worthy the attention of the curious. The court of the palace is surrounded with two piazzas, twelve feet deep, supported by Ionic columns, and on each side are magnificent stables, which being arched, have escaped the fury of the flames. In one of these, which contains 48 stalls, each six feet wide, the racks are of copper, and the pillars of the stalls of brick stuccoed; and in another, both racks and pillars are of Norwegian marble. There are also two lateral courts surrounded with buildings; and the whole stands in a kind of island formed by a canal, which communicates with the harbour. The *Kongens nye Tow*, or the king's new market, is a spacious and irregular area situated nearly in the centre of the city. On one side is the castle of Charlottenberg, part of which is now appropriated to the Royal Academy of paintings, architecture, and sculpture; and in the middle of the area, is an equestrian statue of Christian V. in bronze. The observatory, erected by Frederick V. for a disciple of Tycho Brahe, is particularly deserving of attention. It is built in the form of a cylinder, about 70 feet in diameter, and 130 in height, and has a spiral carriage road of brick to within 20 or 25 feet of the top. From the rooms where the astronomical apparatus is kept, there is a very fine and extensive prospect, and it is considered as the most eligible situation for obtaining a complete view of the city, which, with its beautiful spires, elegant streets, numerous canals and vessels, appears like a map spread under our feet. But what gives us most pleasure to contemplate in this quarter of the city, is a simple and elegant pillar of Norwegian granite, situated without the walls near the western gate, and which was erected in honour of the late king, in commemoration of his granting freedom to all the peasants on the crown lands. The four corners of the pedestal are occupied by four figures of white marble, representing peace, plenty, content, and industry; and on marble slabs inserted into the granite, are engraved the following inscriptions: "For Christian den syvende de Danskes og Norskes Konge af eenige og tanknemmelige Borgere." *To Christian the Seventh, king of the Danes and Norwegians, by some grateful citizens.* And on the opposite side: "Grundsteuen bler lagt af Frederik Kongens son Folkets ven, 1792." *The foundation stone was laid by Frederick, the king's son, the people's friend*, 1792. The old town contains also the dock, the exchange, the university, and the royal college, besides several handsome churches and hospitals.

The new town, which was raised by Frederick V. is extremely beautiful, and consists chiefly of an octagon, and four broad streets leading to it in opposite directions. The grand entrance is through a gate, composed of double rows of Corinthian pillars, with a rich entablature. The octagon contains four uniform and elegant palaces, with two wings each; and in the centre is an equestrian statue of Frederick V. which was erected at the expence of the Danish East India Company, and is said to have cost £80,000. One of these palaces is the present residence of the king; another is allotted to the lodging and education of young navy cadets; and the other two are usually occupied by different members of the royal family. At the extremity of one of the streets is Frederick's church, which, though begun many years ago, and though large sums of money have been expended upon it, is left unfinished, and the materials lie scattered over the church-yard. The Danes pretend that the ground is deficient, and that the foundation cannot bear the weight; but it is suspected that the real cause is the want of money. Its plan and style of architecture are grand and elegant, and it was intended to be finished in a manner worthy of the Danish capital. The walls, inside and outside, were all to be of polished Norwegian marble; and one of the blocks, intended as part of a front pillar, ready hewn and polished, Mr M'Donald found to be nine feet in diameter; and "being part of a Corinthian pillar," says he, "the height of that pillar, to make it in due proportion to its diameter, must, pedestal and capital included, have been intended to be about ninety feet." It, however, shews, as well as the palace of Christiansburg, that the Danes have a higher idea of their own consequence than their neighbours are willing to grant; and the ruins of this unfinished church, like some of our own buildings, it is to be feared will long remain a monument of the pride and poverty of its founders. The small Gothic palace of Rosenberg, said to have been built by Inigo Jones, stands near the rampart a little east of the north gate. It contains the state apartments, where the king holds his annual bed of justice; and its gardens, which are very extensive, are the principal promenade of the Copenhageners. In this division of the city, are also the botanic gardens, Frederick's hospital, &c.

Christianshafen is built upon the island of Amak, which is considered the kitchen garden of Copenhagen, and supplies it with milk, butter, cheese, fruit and vegetables, in great plenty. It is connected with old Copenhagen by two bridges across the harbour, and contains the dock-yards where ships of war are refitted, and the marine arsenal. This last was most abundantly furnished with naval stores of every description, before it was plundered by the British in 1807. The magazines, forges, and workshops, are all upon an excellent construction; and the rope-walks are each 1000 feet long. Ship-building, indeed, is nowhere better understood than at Copenhagen, and its admirable harbour can also afford it advantages in this respect superior to those of almost any other city. The harbour of Copenhagen is formed by the straits of Kelleboe, which separate Zealand from Amak. It is capable of holding 500 ships, and lies completely within the fortifications of the town. The entrance is so narrow, that only one ship can enter at a time; and is protected by the cannon of the citadel, and several other batteries, of which the most formidable is that of the three crowns. Ships of the line are thus moored in the very heart of the city with their bowsprits rising above the windows of the houses; and merchant vessels are brought by the canals close to the warehouses that line the quays. Every ship of war has its particular station, with a separate storehouse on the water's edge opposite to where she is moored; and when the Danish navy was in its glory, the scene was truly rich and interesting; but "the fleet is gone," says a modern traveller, "and the view is dismal to those who once saw the harbour and arsenal in Denmark's better days." With the fleet has also departed, in a great measure, the bustle of industry and commerce; and Copenhagen, placed by nature as the emporium of the Baltic, is left to languish in inactivity from the timid and cautious policy of its ruler. Its foreign trade, which was very extensive, was chiefly with Germany, France, Portugal, Italy, and the countries on the Baltic and Mediterranean. Its West India trade was also very considerable; and Copenhagen received almost exclusively the return cargoes from the islands of St Thomas, St Croix, and St John.

Of its East India trade, which was formerly so extensive, and which was rapidly increasing towards the end of the last century, not a vestige remains. During the year 1783, there arrived at Copenhagen 5100 ships, besides 5 from China, 9 from India, and 127 from America; and in 1805 the arrivals were as follows:

Arrivals in 1805.	Ships.
From India and China	24
From America	68
From different foreign ports	1572
From Danish ports	2774
From the ports of Holstein	748
From the ports of Norway	416
Total	5602
Departures in 1805.	
For the national ports	3975
For foreign ports	1720
Total	5695

The principal domestic trade of Copenhagen is with Norway, Iceland, and the Faro Isles. From the former it draws all its cannon, shot, anchors, and iron-work Russia supplies it with flax, hemp, and masts, and also with some sailcloth and cordage; Sweden with pitch and tar, and Germany with oak. The most valuable manufactures in this city are woollen-stuffs, silk, calico-printing, and porcelain.

Copenhagen is distinguished for its numerous public establishments, and charitable institutions. There are 22 hospitals, and 30 poor-houses. Of these, however, the lying-in-hospital only deserves particular attention, the others being conducted in a manner similar to those of other countries. This institution is an excellent school for medical practitioners, and upwards of a thousand females are annually delivered within its walls. It is open to patients of every country, character, and denomination. All are indiscriminately admitted, without any questions being asked; and they are allowed, if they choose, to be veiled during the whole time of their confinement: the mother is also permitted to leave the child in the hospital, which is frequently done by such of the poorer class as have illegitimate children. Since the commencement of this establishment, the inhuman practice of child-murder has been unknown in this metropolis. The principal literary societies of Copenhagen are, the Royal Academy of Sciences, instituted in 1743, and which has published fifteen volumes of Transactions in the Danish language; the Royal Economical Society, founded in 1768, which possesses an annual income of nearly £1200 sterling, and whose object is to promote the fine arts, fisheries, agriculture, horticulture, &c.; the Medical Society, established in 1772; the Society for Icelandic Literature, in 1779; and a board of longitude in 1784. The state of literature in Copenhagen, however, is rather at a low ebb. Attempts have of late been made by some of its literati to force their language into elegance and popularity, but their compositions are in general clumsy; and in the belles lettres, eloquence, and the higher poetry, they confess themselves still far behind. The Royal Library is a very good collection, consisting of from two hundred and seventy to three hundred thousand volumes. It is principally distinguished for its printed and manuscript editions of the classics, and for an extensive collection of MSS. in the Icelandic tongue, written between the 11th and 14th centuries. Three thousand dollars, which are annually allowed by government for its support, are applied, with classical discernment, in the purchase of the most valuable works that are published, either in Great Britain or on the continent. The press of Copenhagen itself has of late produced specimens of printing equal to those of any other country. The large folio work, *Flora Danica*, and the *Ruris Otia*, are worthy of the first cities of Europe; and an edition of the Four Evangelists, lately printed in Greek, is not inferior to that of either Foulis or Baskerville. The University of Copenhagen was founded by Christian I. in 1479, and has been richly endowed by his successors. It consists of four colleges, and is generally attended by five or six hundred students. The professors have liberal salaries; and 168 poor scholars are provided with lodgings, fire-wood, and three shillings sterling a week. Its library contained about 4000 volumes, chiefly upon theology and jurisprudence, besides about 2000 manuscripts. But the greatest part of its buildings was destroyed by the British bombardment in 1807.

About a mile from the city is the national tomb of the gallant men who fell in the battle of Copenhagen roads on the 2d of April 1801. It is a pyramidal hillock, planted with sapling poplars, with tomb-stones in front, recording the names of the officers who fell, and their respective ships. It is inclosed with a square pallisado; and an obelisk of grey marble, standing on a pedestal of granite, bears the following inscription: "*To the memory of those who fell for their country, their grateful fellow-citizens raise this monument April* 2. 1801;" and beneath, on a white marble tablet, under a wreath of laurel, oak, and cypress, is engraven, "*The wreath which the country bestows never withers over the grave of the fallen warrior.*"

Besides the cathedral, which was destroyed during the last siege, there are in this city 20 churches, one French Protestant church, and several Jewish synagogues.

Copenhagen owes its origin as a city, to a castle which was built here in 1160, by Archbishop Wide, to defend the coast against the pirates which then swarmed in the Baltic. The protection which the castle afforded, and the convenience of the situation as a port, soon induced many of the islanders to prefer it for their residence; and it gradually increased in size and population, until it became the seat of the court in 1443, during the reign of Christopher of Bavaria. Since that time, Copenhagen may be said to have been more than once entirely rebuilt, as there is perhaps not a house in it 200 years old, and the greatest part of them, indeed scarcely above 50. This has been occasioned by the dreadful conflagrations to which it has been frequently exposed; and to which must be attributed its present modern and regular appearance. The fire of 1728, in 48 hours swept away the most elegant part of the city; and 67 streets, containing 1650 dwelling-houses, four churches, the university, and several other public edifices, fell victims to its fury. In 1794, between 900 and 1000 buildings, including the church of St Nicholas, and the royal palace of Christiansburg, were completely destroyed by a similar calamity; and scarcely were the streets rebuilt in the following year, when another part of the city was reduced to ashes. Copenhagen also suffered severely during the last siege in 1807. The cathedral with 305 houses were destroyed, and about 600 damaged by the bombardment; and the number of persons that perished is reckoned at 600, and as many severely bruised. It is to these calamities, however, that Copenhagen owes its present state of beauty and regularity; and, in proportion to its extent, it contains fewer houses that can be called mean, than any town in the world.

The population of Copenhagen has increased considerably during the present century. In 1799, it amounted to 82,608 inhabitants; while in 1806, the return was 95,000. In 1809, however, it was reduced to 90,000. It has, indeed, fluctuated for the last ten years between 85,000 and 100,000. See M'Donald's *Travels through Denmark and part of Sweden in* 1809, vol. ii. p. 16. Coxe's *Travels into Poland, Russia,* &c. vol. ii. p. 524. Carr's *Northern Summer*, p. 42. Catteau *Tableau des Etats Danois*; Anderson's *Tour in Zealand in* 1802; and Catteau-Calleville's *Tableau de la Mer Baltique*, vol. ii. p. 321. Paris, 1812. (*p*)

COPERNICUS (Nicolas,) or Zepernick, a celebrated astronomer, and the restorer of the true system of the world, was born near the old gate of Thorn in Prussia, on the 19th of February 1473.* His father was a surgeon in Thorn, and his mother's brother, Lucas Walzelrodt, or Waisselrodt, to whom he owed all his promotion, was Bishop of Ermeland, a situation to which he was raised a few years after the birth of his nephew.

After receiving the first rudiments of education in his native city, Copernicus was sent to study physic at the university of Cracow, where he received the academical degree of Doctor of Medicine. During the prosecution of his medical studies, his mind was constantly directed to mathematical subjects, and he is said to have indulged with particular pleasure in the study of perspective, and in the practice of painting. After attending the mathematical lectures of Albert Brudzevius, his ardour for astronomy received a new excitation; and he aspired to the glory of emulating Purbachius and Regiomontanus, two of the most celebrated mathematicians of his time. With this view he went to Italy,† and received lessons in astronomy from Dominic Maria of Ferrara, who was professor of mathematics at Bologna, and who speedily discovered the great talents of his pupil. From being the pupil, Copernicus became the friend and coadjutor of Maria, and there is reason to believe that Maria's hypothesis of the variability of the axis of the globe, suggested to Copernicus the idea of explaining the celestial phenomena by the motion of the earth. In 1497, Copernicus first observed the occultation of Aldebaran by the Moon.

From Bologna, Copernicus went to Rome, where he employed himself in teaching mathematics, and in making astronomical observations; and such was the respect which his talents had at that time inspired, that after his return to his native country, he was consulted, in the year 1516, by the clergy of Rome respecting the proposed reformation of the calendar.‡ Copernicus had by this time been appointed to a canonry in the chapter

* The date of Copernicus's birth in the text is given on the authority of Mæstlinus, and is reckoned the most probable by Gassendi. Junctinus says that he was born on the 19th January 1472.

† Copernicus is said to have been sent to Italy at the expence of the chapter of Ermeland, but there is no evidence of this, and it is more probable that his journey was the result of an ardent desire to become a great astronomer.

‡ Paul Middelburg, Bishop of Fossombrona, who had made himself known by a work entitled, Magistri Pauli de Middelburgo *Prognostica ad viginti annos duratura*, Coloniæ, 4to, 1484, presided over the council, which was appointed to consider the reformation of the calendar. He wrote several letters to Copernicus, soliciting his assistance on this occasion. This application was strengthened by letters from Copernicus's friend Bernard Scultetus, dean of Frauenberg, who had been chosen secretary by the council; but his mind was engrossed with other pursuits, and he was unwilling to hazard an opinion upon a subject which was not the result of ma-

Copernicus. of Frauenberg, by his uncle the Bishop of Ermeland, and the inhabitants of his native town had nominated him archdeacon of the church of St John. His principal residence, however, was at Frauenberg, and in this sequestered retreat he devoted himself with zeal to the duties of his office, and to the study of astronomy. The house which he inhabited as one of the sixteen canons was situated on the brow of a mountain, and as it commanded a most extensive view, it was particularly favourable for astronomical observations.

The immobility of the earth in the centre of the system was a doctrine universally received among astronomers; and, independently of its coincidence with vulgar observation, it received no small support from the authority of Scripture, and from the still more imposing sanction of Plato and Aristotle. It required, therefore, no ordinary degree of courage to assail a doctrine so strongly entrenched among the prejudices and superstitions of the human mind, and no ordinary degree of genius and abstraction to establish the true system of the world by direct reasoning and observation. Copernicus was particularly struck with the disorder and confusion which prevailed in the Ptolemaic system, and with the absurdity of supposing the planets to revolve uniformly round a centre different from the centre of their orbits; and with the view probably of defending himself by authority as well as by argument, he appears to have begun his inquiry into the true system of the world, by an historical examination of the various opinions which were held by ancient authors.

The opinions of the ancient Egyptians, of Pythagoras, of Philolaus, Aristarchus, Apollonius Pergæus, Nicetas, Heraclides, and Martianus Capella, all countenanced the general notion which he had formed; but it appears* that he attended principally to the system explained by Martianus Capella,† a Roman author of the fifth century, who placed the Sun between Mars and the Moon, and made Mercury and Venus revolve round him as their proper centre; and to the still more complete hypothesis of Apollonius Pergæus, who made the superior as well as the inferior planets revolve round the Sun, while the Sun and Moon revolved round the Earth in the centre of the world.

Guided by these opinions, and by the general principles which he had early entertained respecting the simplicity and harmony of the system, Copernicus was gradually led to the opinion, that the Sun was immoveable in the centre of the universe; that his apparent motion arose from the annual motion of the Earth, which, like all the other planets, revolved round the Sun as their centre; and that all the diurnal phenomena of the heavens were owing solely to the rotation of the Earth about its axis every 24 hours.

After completing this beautiful system, which he had begun to form about the year 1507, he resolved to establish it by the evidence of actual observation. With this view, he determined to make a series of observations upon all the planets, and to construct tables of their motion more correct than those of Ptolemy, or the Alphonsine Tables. He accordingly constructed a quadrant with moveable radii like that of Ptolemy, and also a parallactic instrument, the largest moveable radius of which was divided into 1414 parts, in order to form the hypothenuse of a right-angled isosceles triangle, whose sides were four feet long, and were divided into 1000 parts.‡ With the aid of these instruments, Copernicus made an immense number of observations, which were published along with those of Tycho in 1666, and by means of which he computed his new tables of the planets, and brought to a conclusion, in 1530, his great work on the revolutions of the celestial bodies.

Afraid of alarming the prejudices of the public, Copernicus declined to publish his great work, and resisted the most pressing solicitation of his friends. The Cardinal Nicolas Schonberg, Bishop of Capoua, wrote to Copernicus in 1534, inviting him to publish his new system, and Tydeman Gyse, Bishop of Culm, who appears to have been formerly one of the canons at Frauenberg, made a similar application, in the strongest and most urgent manner. In the year 1539, George Joac. Rheticus, who was Professor of Mathematics at Wittenberg, resigned his chair in that university, and repaired to Frauenberg, for the purpose of making himself master of the discoveries of Copernicus, and they appear to have arranged a method of laying them before the world, without communicating any violent shock to the public mind. In order to pave the way for the work of Copernicus, Rheticus published in the year 1540, but without his name, and under the disguise of a student of mathematics, a general account of the new system. This book was entitled, *Ad clarissimi, v. d. Io. Schonerum, de Libris revolutionum eruditissimi viri et mathematici excellentissimi, reverendi Doctoris* Nicolai Copernici *Torunnæi, Canonici Varmiensis, per quendam juvenem mathematicæ studiosum narratio prima.* Gedani, 4to. The public having received this work without any marks of disapprobation, Rheticus ventured a step farther, and published a second edition of it at Basle in 1541, with his own name, entitled, *De Libris revolutionum Nic. Copernici narratio prima per* M. Georg. Joac. Rheticum. Item, *Borussiæ Encomium, ab eodem.* Basiliæ, 8vo.

In the same year the discoveries of Copernicus were noticed in the most flattering manner by Erasmus Rheinhold, in an edition of Purbachius's *Theoricæ Novæ Planetarum,* which he published at Wittenberg. He speaks of a second Ptolemy being wanted to restore the degenerate science of the age; and, alluding to Copernicus, he expresses a hope that such a person will be found in Prussia, whose divine genius posterity will justly admire.§

Encouraged by the success of these publications, Copernicus at last ventured to put his own work into the hands of Rheticus, which was printed at Noremberg in 1543, at the expence of Cardinal Schonberg, and with the following title, Nicolai Copernici *Torinensis de*

ture deliberation. In the dedication, however, of his work to Pope Paul III. he says, that after he received the application from the Bishop of Fossombrona, he set himself to determine the length of the year and of the month, and the other motions of the Sun and Moon that were necessary for this purpose.

* Copernicus *De Revolutionibus Orbium Celestium,* lib. i. cap. x.

† This author wrote a book in A. D 410, entitled, *De Artibus Liberalibus,* in the 8th book of which he treats of Astronomy.

‡ This instrument was presented by Hannof, canon of Ermeland, to Tycho Brahe, who set a great value upon it.

§ "*Tametsi video,*" says Rheinhold, speaking of Copernicus, "*quendam recentiorem, præstantissimum artificem (qui magnam de se apud omnes concitavit expectationem restituendæ astronomiæ et jam adornat editionem suorum laborum) sicut in aliis astronomiæ partibus, ita etiam in hac varietate motus Lunæ explicanda διαπασων dissentire a forma Ptolemaica.*" And in another place, "*Itaque cum hæ artes jamdiu desiderant aliquem Ptolemæum, qui labentes disciplinas revocet; spero eum nobis tandem ex Prussia obtigisse, cujus divinum ingenium tota posteritas non immerito admirabitur.*"

Copernicus. *Revolutionibus orbium celestium libri vi. Habes in hoc opere jam recens nato et edito, studiose lector, motus stellarum tum fixarum quam erraticarum, cum ex veteribus tum etiam ex recentibus observationibus institutos, et novis insuper ac admirabilibus hypothesibus ornatos. Habes etiam tabulas expeditissimos ex quibus eosdem ad quodvis tempus quam facillime calculare poteris.* IGITUR EME, LEGE, FRUERE. Apud Jo. Petreium. Norimbergæ, in folio. This admirable work its author did not live to read. He received a copy of it, which he saw and touched only a few hours before his death, which happened at Frauenberg, in consequence of the rupture of a blood vessel, and a palsy in his right side, on the 22d of May 1543, three months and three days after he had entered the 73d year of his age.

While Copernicus was pursuing his astronomical discoveries at Frauenberg, his mind was occasionally directed to other objects. He was appointed administrator of the possessions of the chapter in the bailliage of Allenstein, and as he was obliged to reside here occasionally, he had a room fitted up for temporary observations. He is said also to have been appointed to an office in the mint, and to have left a work on that subject, which is still preserved in some town of West Prussia. This fact, however, is stated only on the authority of Count Thadæus Czacki. In 1502, Copernicus went as representative of the chapter of Frauenberg, to an assembly which was held at Graudenz, for the purpose of considering the state of the money system, and he took an active part in endeavouring to effect an uniformity of money in the different provinces of Prussia.

When the bishop happened to be absent, Copernicus was entrusted with the charge of the diocese, and he was chosen general vicar during the vacancies which followed the deaths of two prelates. At the death of Bishop Maurice in 1537, Copernicus was one of the four who were nominated by King Sigismond as the candidates from among whom the chapter of Ermeland were to choose their bishop.

Copernicus appears to have likewise employed himself as a civil engineer. There happened to be no springs of water on the hill of Frauenberg, on which the canons resided: in order to remedy this inconvenience, he constructed, half a mile higher up the river, an oblique dam 15 ells and a half long, and he erected a mill by which the water was raised with a wheel to the top of a tower, from which it was conveyed by pipes to the house of each canon.* This machine, which is now in ruins, is said to have been the model for the great hydraulic machine at Marly.

It is a singular fact in the history of Copernicus, that, while he himself was zealously engaged in establishing a system in direct opposition to the faith of the catholic church, he should have viewed with indifference, and even with hostility, the great reformation which Luther was accomplishing in Germany. An edict was even issued by Maurice, bishop of Ermeland, in 1526, and signed by Copernicus and the other canons,† the first article of which was directed against the exertions of Luther; and it is certainly a remarkable circumstance, that the diocese of Ermeland, illuminated by the wisdom of Copernicus, should have preserved the Catholic religion, while all the surrounding provinces had embraced the doctrines of the Reformation. Copernicus.

About the commencement of the present century, when the science of astronomy was very generally cultivated on the continent, an attempt was made by the Society of Sciences at Warsaw to discover some traces of Copernicus, and Count Thadæus Czacki and Colonel Molski were sent to Frauenburg for this purpose. In the house where Copernicus resided, which was then possessed by an evangelical Lutheran pastor, there were some manuscript verses pasted to the chimney piece, and written in Copernicus's own hand; but about 15 years before, a pastor who had left the place, had carried them off as a memorial of that great astronomer. The name and arms of Copernicus were also painted in colours on a pane of glass, but this valuable relic, after having been preserved three centuries and a half, was also carried off 12 years ago. Over the door of the house is shewn a place where there was an aperture through which the rays of the sun were admitted into another chamber. This aperture, which was probably used as a gnomon, was filled up about six years ago by the present possessor. The tower in the neighbourhood on which Copernicus made his observations, is in a state of bad repair, and is used only for the confinement of prisoners. From a manuscript letter of Copernicus, written a few days before his death to the King of Poland, and dated at Frauenberg, which has been carefully preserved in the archives of Warsaw, it appeared certain that Copernicus had died at Frauenberg, and not at Thorn, as some persons had supposed; and as he was chancellor of the chapter, to which office a particular altar was annexed in the cathedral church, the travellers presumed that he was interred beneath this altar. Near this spot they found a grave-stone, partly covered by a marble ballustrade which surrounds the altar. Spheres cut out in relief, and the letters *Nicol*, pointed out the place where the ashes of the astronomer were deposited. Having obtained permission from the chapter to remove every obstruction, the travellers washed the stone, and found the following letters—

NICOL . . . COP . . . . CUS
AN . . . M

the remainder of the inscription being completely effaced. After raising the stone, they found common yellow sand, and in the middle of it a little black earth, under which were found the remains of mouldering bones. A part of them were kept by the chapter, and five were given to the travellers. The travellers then searched for the manuscripts of Copernicus, but they found only some of his letters on private affairs, and a few of his signatures among the acts of the chapter.

The attention of the chapter having been thus directed to the memory of Copernicus, they ordered a marble to be engraved with his portrait and inscriptions, which has been placed in the wall opposite to the altar where he was interred.

It is impossible to survey the preceding sketch of the life and discoveries of Copernicus, without being struck

* The following inscription was engraven on the tower:—

"Hic patiuntur aquæ sursum properare coactæ,
Ne careat sitiens Incola mentis ope,
Quod natura negat tribuit Copernicus arte,
Unum pro cunctis Fama loquatur opus."

† The edict begins thus:—"Nous Maurice, par la grace de Dieu, Eveque; Jean Ferber, Doyen; Tydeman Gyse, Custos; Jean Sculteti, Archidiacre, *Nicolas Copernic*, Chanoine, et tout le Chapitre des Eglises de la Wurmie ayant consideré, &c."

at the indifference with which the church of Rome witnessed the propagation of a system so adverse to the principles of its faith. More than a century afterwards, when civilization and liberal sentiment had made considerable progress, Galileo was persecuted for holding the same opinions which Copernicus had propagated with impunity. We cannot allow ourselves to imagine that the church was less vigilant in 1530 than in 1634, or that the doctrine of the earth's immobility was less heretical at the one period than at the other. We are therefore led to consider the persecution of Galileo rather as the consequence of his personal imprudence, than of his astronomical opinions, and to imagine that the cardinals had seized the opportunity which the publication of his dialogues presented, of gratifying a private resentment, which might possibly have been well-founded Upon what other supposition can we account for the extreme severity of the church against the Pisan philosopher, and for its total indifference to the same crime in the canon of Ermeland. The publication of Copernicus's system gave no shock to the public mind; the religious feelings of no individual, and the watchful jealousy of no tribunal, were alarmed. The most distinguished members, on the contrary, of the Catholic church, encouraged and promoted the propagation of the new system. The Cardinal Nicolas Schonberg pressed Copernicus to publish his discoveries. The Bishop of Culm employed his influence in the same cause. The work was dedicated to the Pope himself.† The King of Poland even proposed him a candidate for the vacant bishopric of Ermeland; and 38 years after his death, Cromerus, Bishop of Ermeland, erected a monument to his memory. The charge of heresy was never preferred against Copernicus either during his life, or after his death; and we have never been able to discover, that the slightest disapprobation had been either cherished or expressed against his system of the universe. Had Galileo been canon of Ermeland, and Copernicus professor of mathematics at Pisa, religion would never have been degraded by the persecution of the philosopher, nor science afflicted at the ignominious compromise by which it was averted. See Gassendi *Nicolai Copernici Varmiensis Canonici Astronomi illustris vita*, published at the end of the life of Tycho Brahe; and Bernoulli's *Travels*, vol. iii. page 18. (β)

COPIAPO. See CHILI.

COPPER. See CHEMISTRY, MINES, and ORYCTOGNOSY.

COPROSMA, a genus of plants of the class Polygamia, and order Monœcia. See BOTANY, p. 343.

COPTS, a name given to the descendants of the ancient Egyptians, who profess the Christian faith, according to the Jacobite or Eutychian heresy. They consider the name Copts as a nickname, and call themselves by the name of Jacobites, from Jacobus Zanzales, bishop of Edessa, who travelled over a great part of the East, to propagate the doctrine of one nature in Christ, and died in the year 578.

The Copts have a patriarch, or metropolitan, at Alexandria, who is head of the whole Coptic church, and is said to have one hundred and forty bishoprics in Egypt, Syria, Nubia, and other countries, subject to his patriarchate, besides the Abuna of Abyssinia, who is also nominated and consecrated by him. The Coptic church has been so grievously oppressed by the government, that both clergy and laity labour under the most miserable poverty, attended by its usual associate, deplorable ignorance.

Eutychius, patriarch of Alexandria, was the first who maintained the Monophysite doctrine, or the doctrine of one nature in Christ; for which he was excommunicated, and died in exile. Shortly after, however, his party, with Dioscorus at their head, called a council at Ephesus, in opposition to that of Chalcedon, which had condemned Eutychius; and, in their turn, excommunicated the pope, and all the bishops who adhered to him. This is the origin of the fatal breach between the Latin and Alexandrian churches, which has continued ever since, in spite of all the efforts of the church of Rome to effect a union. Dioscorus did not long enjoy his triumph; he was anathematized, and banished; and Prolerus, whom the court of Constantinople had nominated his successor, was assassinated in the cathedral on *Good Friday*, 477, on a sedition raised by the Monophysites, who had already chosen another patriarch.

From that time there have been two patriarchs; the one of the Greeks, styled orthodox, the other of the Copts, called schismatics. The Greek party continued for a considerable time to maintain the ascendency, till the doctrine of the Copts was revived, and their party strengthened, by the preaching of Jacobus Zanzales, from whom they assumed the name of *Jacobites*. The Jacobites were always discountenanced by the government, and denounced as heretics by their more powerful rivals in the church, till the invasion of Egypt by the Turks; when, in hopes of being revenged on the Greeks, or of obtaining better terms from the Infidels, than under the government of professing Christians, they readily joined the invaders, and, it is said, outdid the Turks in their hatred and cruelty to the Greeks. In consequence of this alliance with the conquerors, they obtained a confirmation of all their former privileges, and enjoy, from the Turks, a superiority of regard over their rivals the Greeks.

With respect to the rites of the Coptic church, circumcision is universally adopted, and considered so essential, that it is administered to both sexes. (See CIRCUMCISION.) Baptism is not considered as so necessary. Confession is admitted; but instead of a private, auricular, and particular confession of sins, a public and general one is admitted; and the sinner obtains absolution on very easy terms. The Copts are particularly strict in their fasts, during Lent and Advent, when they eat neither flesh, fish, fowls, nor eggs, and use neither butter nor oil. Children of ten years of age, and also the sick and the dying, are compelled to observe the same strict abstinence, which is, in some de-

† There is a curious passage in this dedication, where Copernicus states, that the reason of inscribing his book to his Holiness was, that the authority of the pontiff might put to silence the calumnies of some individuals, who attacked his system by arguments drawn from passages of scripture twisted for their own purpose. As the passage is peculiarly interesting, our readers will be gratified with the original words. "Ut vero pariter docti, atque indocti viderent, nullius omnino subterfugere judicium, malui tuæ sanctitati, quam cuiquam alteri has meas lucubrationes dedicare; propterea quod et in hoc remotissimo angulo terræ, in quo ego ago, ordinis dignitate et literarum omnium, atque mathematices etiam amore eminentissimus habearis; *ut facile tua auctoritate et judicio calumniantium morsus reprimere possis*; *etsi in proverbio sit non esse remedium adversus sycophantæ morsum.* Si fortasse erant *ματαιολογοι*, qui cum omnium mathematum ignari sint tamen de illis judicium sibi sumunt *propter aliquem locum Scripturæ male ad suum propositum detortum, ausi fuerunt* meum hoc institutum reprehendise ac insectari; illis nihil moror, adeo ut etiam illorum judicium, tanquam temerarium contemnam."

gree, rendered necessary by their extreme poverty. The marriage service is read by the priest in the ancient Coptic, which is now understood by few even of their learned clergy. Divorce is allowed on very frivolous pretences; and may be prosecuted by either party, on the mere grounds of a simple dislike.

In short, the rites and doctrines of the Coptic church are much the same as those of Abyssinia, where they form the established religion of the country, and are strictly and universally observed.

The patriarch of Alexandria is chosen by the bishops of the Coptic church. He is first installed in the great church of St Macarius, at Cairo, where he is elected; and afterwards at that of St Mark, at Alexandria. He is obliged to preach once a year to his clergy; whilst their employment is to read, on set days, homilies and legendary tales to the laity. The person next in dignity to the patriarch of Alexandria, is the titular patriarch of Jerusalem, who resides at Cairo; and visits Jerusalem every Easter, together with the other places in Palestine, which acknowledge his jurisdiction. He has the government of the Coptic church during a vacancy of the patriarchal see.

Many ineffectual attempts have been made to unite the Coptic to the Roman church. About the year 1560, the patriarch of Alexandria wrote a letter to the Pope, in which he seemed to acknowledge his authority, stiling him *father of fathers, pastor of pastors,* and *master of all churches.* The Pope, overjoyed at this apparent submission, sent a nuncio to Alexandria, with a sum of money to the patriarch. After the money was delivered, the nuncio was informed, that the designations which the patriarch had given to the Pope in his letter, were merely complimentary titles, which he occasionally bestowed on his friends; and that each of them must still remain the head of his own church.

There have been many disputes about the origin of the word *Copts.* Scaliger first supposed it to be derived from Coptos, a celebrated town of ancient Egypt: he afterwards supposed it to be derived from the word Αιγυπτος, by omitting the first syllable. The objection to both these etymologies is, that *Copts* is entirely a modern appellation, not known before the conquest of Egypt by the Mahometans. Others have again supposed, that, as the name is confined entirely to the *Jacobite* Christians, it is merely an abbreviation of this word by omitting the first syllable, making Cobite, and hence Copt by an easy mutation. Many other etymologies have been proposed, all equally uncertain and unsatisfactory. (*v*)

COPYHOLD, in the law of England, is a species of land tenure, which is evidently the offspring of the ancient tenure in *villenage.* It is so called because the tenant holds his lands by copy of court roll of the manor, at the bill of the lord.

Villeins might, anciently, be enfranchised either by express or implied manumission, to which law and practice were extremely favourable. In process of time, the villeins, by a series of encroachments on their lords, came to have a more secure and permanent interest in their possessions; and, at length, the common law gave them a title to prescribe against their lords, so that, when they and their children had continued to enjoy their lands, time out of mind, by a regular course of descent, they began to be called tenants by copy of court roll, and their tenure itself a copyhold. These lands, therefore, were now no longer held at the mere will of the lord, but at the will of the lord *according to the custom of the manor;* and so long as he conformed to that custom, the tenant could not be ejected. Tenure in villenage was virtually abolished by the statute of Charles II. but copyholds were reserved.

In order to constitute a copyhold tenure, it is necessary, 1st, That the lands be parcel of, and situate within, that manor under which they are held; and, 2d, That they have been devised, or devisable, by copy of court roll immemorially; for, strictly speaking, no new copyhold can be granted at this day. See Blackstone's *Comment.* b. ii. ch. 6. (*z*)

COPYING MACHINE. See POLYGRAPH.

COPYRIGHT. See LITERARY PROPERTY.

COQUIMBO, or LA SERENA, the capital of a province of the same name in Chili, was founded by Valdivia in 1544. It is situated in the valley of Coquimbo, from which it receives its original name; but Valdivia called it La Serena, from the province in Old Spain in which he was born. The town is delightfully situated at the distance of a quarter of a league from the sea on the river Coquimbo, and commands an extensive prospect of the ocean, the river, and the surrounding fields and woods. The streets are straight and broad, and stretching from north to south, and from east to west, they form squares of buildings, the wide spaces between the squares being entirely occupied by gardens planted with fruit trees and esculent vegetables. The houses are built of mud and covered with leaves, and their mean appearance is taken away by the richness of the gardens.

The principal public buildings are the parish churches, five convents belonging to the Franciscans, the Dominicans, the Augustines, the Fathers of Mercy, and to St Juan de Dios, and a college formerly belonging to the Jesuits. The churches belonging to these orders are large and respectable. The parish church forms part of the great square, and on the opposite side is the town-house where the corporation meets, which consists of the corregidor, the alcaldes, and the regidores. The river Coquimbo runs on the north side of the town, and by means of canals supplies the town with water for the use of the gardens. There is a fine bay at the mouth of the river, where ships can ride in security, and at the port of Coquimbo, two leagues distant from the city, several vessels from Peru load annually. When Ulloa visited Coquimbo, the population did not exceed four or five hundred families, consisting of Spaniards, Mestezos, and a few Indians. West Long. 71° 19′ 15″, South Lat. 29° 54′ 40″. See Ulloa's *Voyage to South America,* book viii. chap. viii. vol. ii. p. 267, and Molini's *Account of Chili,* vol. i. p. 296. (*π*)

CORAL FISHERY. The ornamental purposes to which coral has long been applied, and the confidence in its virtues entertained by the older physicians, have rendered its acquisition an object of considerable anxiety. The quantities accidentally detached from submarine recesses, and occasionally washed ashore, being insufficient to supply the demand, different means have been adopted to withdraw it from the places of its natural vegetation.

The more valuable species of coral are peculiar to the warmer climates; and in some of these, divers are accustomed to descend in quest of it, carrying down a sponge dipped in oil. As the effect of oil is to tranquillize the surface of the sea, by allowing a small portion to escape, the waves are lulled, and light can penetrate below. But coral being generally produced at great depths in the sea, and requiring both time and

Coral Fishery.

labour in the collection, other means have been employed, and regular fisheries established for that purpose, particularly in the Mediterranean and Adriatic.

The principal implements in use are, in France, called *engin* and *salabre,* which latter is in Italy denominated *ordigno.* The former is a long spar, retained by two cords from above, and sunk by a weight in the middle: one end is provided with an iron hoop eighteen inches in diameter, opening into a strong hemispherical net. At the opposite sides of the hoop are other two nets, approaching to a triangular or conical form, descending far below. The second implement consists of two long cross spars fixed in the middle, through which a cord passes for retaining it above, and where also a cannon shot is lodged to carry it down. At each of the four extremities of the spars there is a large deep pyramidal net, with meshes of unequal width. These implements are carried out to sea in barks manned by the stoutest fishermen; for it is a service both of fatigue and danger: in some fisheries, the spar of the former implement exceeds the total length of the bark, and is lowered from the side; whereas in others it is shorter, and for safety lowered from the stern.

But, in order to understand how such unwieldy implements may be successfully employed, it is necessary to consider the natural site of coral. Those who have had the best opportunities of observation unite in affirming, that this substance is almost invariably produced in submarine caverns, or on shelving rocks. In the former, it is larger, more abundant, and of greater value. Besides it is usually deep in the sea, as already observed. When the first implement is applied therefore, it is cautiously lowered from the bark, and by means of the two retaining cords, guided under the projecting rocks, or into the recesses below. There the branches of the coral being entangled, are forcibly broke off; and if the stem with the root can be obtained, it is deemed a valuable acquisition; for the great difficulty in fishing coral is to procure it entire. The other implement takes a wider range, and in addition to being used somewhat in an analogous manner, it is employed to recover the portions of coral broken off and lying at the bottom of the sea.

Marsigli affirms, that coral is most abundant in caverns exposed to the south, and where the sea is smooth and tranquil: that it is seldom found in a western exposure, and never to the north. This is in general true, but the tranquillity of the sea is not indispensible to its copious production; and from this results the danger which frequently attends the fishery. Experienced fishermen, aware of the places where it should be found, search them out with extraordinary care and diligence, and the first discoverer is sure to enrich himself by it. But a cavern, however fertile, must be visited at certain intervals; for although the coral, of which it is despoiled, will be renewed, it is only after the lapse of a considerable time. Marsigli judiciously observes, "that a forest of coral may be compared to a terrestrial forest; and after the caverns containing it have been ransacked, a certain interval must be allowed for its renewal. But the sea not being under restricted dominion like the land, the same order cannot be preserved, which is adopted for the renewal of forests. Thus fishermen, by continually resorting to the same places, prematurely break and destroy the growing coral, which time would otherwise bring to perfection."

Marsigli's remarks are corroborated by other philosophers; and the first discoverer of a cavern will reap a fertile harvest, while those who follow can gain little, unless discretion attends their search. But the discovery of such caverns is not reserved for fishermen solely, as Donati, a distinguished naturalist, relates, that by means of the implements above described, he succeeded in finding one of great extent and uncommon fertility in coralline products, at Porto Rosso, in the Adriatic. In illustrating the necessity of a considerable interval being allowed to elapse between the successive fisheries of coral within the same limits, the Abbé Spallanzani informs us, that, in the Strait of Messina, this interval is ten years. The tract occupied for the fishery is divided into ten parts, and one of these only resorted to within the prescribed period of ten years, whereby sufficient time is admitted for the regeneration of the coral, while the fishery is uninterruptedly prosecuted during the season allotted for it. When this law, resulting from experience, is infringed, coral is obtained indeed, but of inferior quality. The most intelligent fishermen maintain, that, in ten years, red coral attains its extreme height, which is about a foot, and that its thickness is scarcely increased ever after; and likewise, that at very great depths, its vegetation altogether ceases. Spallanzani, in considering this fact, observes, that coral fished up from the neighbourhood of San Stefano, where none had been sought within the memory of man, though of a bright red colour, was not higher than ordinary coral, and exceeded it by only about a third in thickness. In certain situations, however, it does not attain the height of half a foot in ten years.

The principal coral fisheries with which we are acquainted are carried on at Marseilles, in the Strait of Messina, and at the Lipari Islands. With regard to the latter, eighteen or twenty barks, belonging to the port of Messina, are employed in it. Each is manned by eight seamen, who are inured to this pursuit, and well acquainted with the navigation of the surrounding seas. They are not exclusively devoted to the fishery, which is followed only when they want other employment; but it is necessary that they should be stout and hardy, both from the attendant labour, and the danger of the occupation. The quantity of coral annually obtained by these vessels is said to exceed 3000 pounds, of various quality, both of a white and red colour, and of different shades. The size and fineness of the coral regulate the price; some is reputed worth ten guineas an ounce, and some is scarcely valued at tenpence a pound; the oldest is the deepest in colour, which is accounted a quality; and there are reckoned no less than nine different shades, from dark crimson to pale carnation. White coral, which is also obtained in the Straits of Messina, is of different shades; but red is the most valuable, and the most constant object of research.

During the months of June and July, the coral fishery of the Lipari Islands is carried on by fifteen barks, but less successfully than in the Straits of Messina. Whether because the substance is exhausted, or the fishermen not equally skilful, each bark, in a particular season, has not collected above 30 or 35 pounds of coral. The superstitions of the people are known to affect such pursuits; for, some years ago, several barks having been cast away in the Mediterranean, a Dominican friar menaced the mariners and others with excommunication, should they prosecute their enterprize. Nothing could be more effectual; and the fishermen, to preserve their peace with the church, were content to forego one of their sources of subsistence.

Formerly the coral fishery of Marseilles was in a flourishing condition, and the barks belonging to it brought great quantities of coral from the African coast; but we are not acquainted with its present state. Most of the coral obtained in the Mediterranean is carried to Leghorn, and from thence dispersed to other countries.

Where coral is situated at great depths, the fishermen cease to search after it, owing to the imperfection of the plant, and the labour of obtaining it. The greatest quantities are recovered from the depth of 60 to 125 feet; and some fisheries are carried on to the depth of 900 feet. "In the Straits of Messina, the grottoes productive of coral are situated nearly in the middle, and at various depths, from 350 feet to 650. The depth increases on advancing towards the mouth of the Strait, where the fishery is no longer prosecuted, the rocks, according to the coral fishermen, being there 1000 feet from the surface." At the depth of 900 feet, it is supposed to require 40 years to attain the same size which it would do in 10 years at 60 feet.

Sometimes, though rarely, the fishermen recover coral, which has another origin than in caverns. Founded on an adventitious substance, it springs perpendicularly from the bottom of the sea, and in this way the plant is obtained entire. By an invariable law, its growth is perpendicular to the plane of position whatever that may be; and in Marsigli's opinion, when produced in submarine caverns, it always depends perpendicularly from above. Branches broke off continue in favourable situations to vegetate, whence, if the root is once secure, the stem rises upwards. But these are considered rare instances, and are rather to be viewed as aberrations from the laws which regulate the production of coral. The implements of the fishermen are therefore adapted both to withdraw the coral from recesses, and to recover it either when falling down to the bottom of the sea, or when growing there.

As the coral fishermen cease to search for that substance at very great depths, neither do they frequent shallows; for it is said that none grows in less than ten or twelve feet of water. By this is probably meant the *Gorgonia nobilis*, or red coral; for there is reason to believe, that in certain climates other species vegetate until they approach the surface. Whole islands, particularly in the East, are said to originate from a base of coral. The animal by which it is formed discontinuing its labours when gaining the surface of the sea, leaves a basis for the accumulation first of earthy and then of vegetable matter, which by gradual accession interrupts the progress of the waves. Hence it has been proposed to guard an open coast by transplanting coral beds for the formation of barriers to the sea: and an instance is quoted of a survey being made on the coast of Sumatra in the year 1784, when two feet and a half of water was found on a shoal. But four years and seven months afterwards the rudiments of an island ten yards in diameter, and bearing a few bushes, was visible on the spot; thus it is probable we are still unacquainted with the greatest and least depths of the growth of coral; and as it is solely of animal origin, many observations made in the conviction of its being a vegetable product are to be received with distrust. See Spallanzani *Viaggi alle due Sicilie*, tom. v.; Tournefort *Voyages*, tom. i. p. 17.; Donati *Storia del Mare Adriatico*; Marsigli *Histoire Physique de la Mer*. (c)

CORCHORUS, a genus of plants of the class Polyandria, and order Monogynia. See Botany, p. 235.

CORCYRA. See Corfu.

CORDAGE. See Rope Making.

CORDIA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 142.

CORDOVA, the *Corduba* of the ancients, is a city of Spain in the province of Andalusia. It is delightfully situated on the north bank of the Guadalquivir, which winds round its walls in the form of a crescent, at the entrance of a spacious plain, which is bounded on the north by branches from the mountainous ridges of the Sierra Morena.

The town, which is nearly of a square form, stretching from east to west, is defended by walls flanked with large towers. It occupies a great space of ground, part of which is covered with gardens and orchards, and its suburbs are sufficiently large to resemble so many separate towns. The largest of these is the suburb to the east of the town, where there are a great number of mills erected on the Guadalquivir. The general appearance of the town is gloomy, the streets being narrow and crooked. The principal square is very spacious, and consists of houses regularly built, and having porticoes all round it. The individual houses in Cordova have, in general, a tolerable appearance, particularly from the fine gardens which are attached to them.

The principal public buildings at Cordova are the cathedral; 15 parish churches; 40 convents for both sexes; the episcopal and the royal palace, two colleges, and 21 hospitals.

The cathedral, which is an old mosque, retaining its original name of Mezquita, was built in the year 170 of the Hegira, on the site of the old Gothic cathedral, which also stood upon the site of the temple of Janus. It is an insulated building of enormous magnitude, conspicuously situated at the meeting of four elegant streets. Its length is 534 feet, and its width 387½ feet. Bourgoanne makes its length 620, and its breadth 440 feet. The stones of which the walls are built are 3½ feet long, 1 foot 9 inches wide, and 6 feet 10 inches thick, and the walls are of different heights, in consequence of the inequality of the ground, which is 30 feet high on three sides, and about 42 on the south side. The north front is covered with exquisite stucco ornaments, and before the door are six beautiful jasper columns, 4 feet 9 inches high. An elegant tower 51 feet 8 inches wide on each face, rises on one side, and its 14 windows are adorned with columns of black and red marble. The tower terminates in a number of small arches, like festoons, supported by similar columns, which, with those of the windows, amount to 100. Before the entrance of the temple is a space 180 feet long, surrounded on three sides with a handsome portico, supported by 72 columns. Below it is a capacious arched cistern, which is sustained by columns, and from the cypress, orange, citron and palm trees, with which the area is planted, and the *jet' d'eaus* which are continually playing, it resembles a garden in the air. There are 17 doors in the cathedral covered with curiously wrought bronze plates, but only five of these are used.

Opening into this area, and running from north to south, are 19 large aisles 350 feet long and 14 broad, having their ceilings of fragrant woods, and there are 17 smaller ones crossing from east to west. They are divided by rows of columns to the number of 850, which, with those of the tower and portico, make 1018,—an assemblage of columns which is perhaps unexampled in the world. These pillars, which are principally of the finest marble, vary from seven to eleven feet three inches in height, and have, in general, Corinthian capitals.

Cordova.

Separated from the rest of the cathedral by a square building, is the chapel in which the Moors preserved the book of the law. It is adorned with fine marbles, and the entablature is supported by 12 columns placed upon the shafts f other 12. It has also a handsome dome. This building is succeeded by another square one, which has a cupola supported by 84 columns of fine marble, and 8 windows with sky lights in alabaster. This building leads to a magnificent octagon, 13 feet in height and width, and ornamented with marbles like the other buildings. In 1528, the cathedral was formed into a cross, by building a chapel in the middle, forming as it were a second church. This venerable building, of which we are able only to give an imperfect account, was visited by the Moors from Africa, even after it had fallen into the hands of the Castilians.

The church of the Martyrs, which belongs to the Dominican convent, is a handsome and ancient building, and contains several fine paintings, with a beautiful marble monument of Ambrosio Moralez. The church of the Capuchins, and that of St Francis also, contain several paintings of great merit. The royal palace, which resembles a citadel, is a large and handsome building, encircled with walls, and situated at one of the extremities of the town. A great number of horses used to be kept in the stables for the king of Spain; and in 1792, there were no fewer than 600 of all ages.

The Episcopal palace, which was occupied by the Inquisition, is a large building, with a noble marble staircase. It has a spacious garden, and a little wood of orange trees. It contains a number of good paintings, and one of the halls is filled with a long series of paintings of the bishops of Cordova.

The college of St Paul, which belongs to the Dominicans, is reckoned one of the finest edifices in Cordova. Its front is of marble, and it has also a magnificent marble staircase. The cloister is particularly fine, consisting of two ranges of porticoes one above the other, and supported by 80 marble columns. The library contains many choice books, and the church some good pictures.

A school for drawing, in which a number of young people without fortune are supported, was established by Bishop Don Antonio Cavalleros, and in 1801, it was under the direction of a painter, a sculptor, and an architect.

Cordova was a commercial town in the time of the Romans. Under the Moors, and also under the Castilians, it carried on a very brisk trade, and could then boast of several celebrated manufactures of silk and gold lace, which are now gone to decay. The principal trade and manufactures which are now carried on, are those of ribbands, lace, hats, and baize. Gold and silver articles are still manufactured here and sent to the fairs. Their store-houses are rich, but their work is neither delicate nor elegant; and although the art of softening leather and giving it a fine polish was invented at Cordova, yet the town possesses few tan-yards.

One of the principal places in the environs of Cordova is the bishop's country house, which is a mile and a half from the town; its gardens and walks are truly magnificent, and the collection of exotic medicinal plants is large and valuable. Though the surrounding mountains are craggy, yet they are covered with gardens, vineyards, and forests of olive and fruit trees. The air is perfumed with the flowers of the orange and the citron tree; and the oranges and citrons are sold for almost nothing in the market, and towards the end of autumn are used for manure.

In the time of the Moors, Cordova is said to have contained a population of 300,000. When the Moors were expelled by Ferdinand, that prince and his successors endeavoured in vain to recruit the population of Cordova; so that about the middle of the seventeenth century, it had decreased to 60,000. When this town was visited by Bourgoanne, the population did not exceed 35,000. See Laborde's *View of Spain*, vol. ii. p. 29; Bourgoanne's *Tableau de l'Espagne;* Semple's *Second Journey in Spain;* Dillon's *Travels through Spain;* and Fischer's *Travels through Spain in* 1797 *and* 1798. (π)

Corduroy.

CORDUROY, (*Cord du Roi*, or *King's Cord*), originally a stout manufacture of silken cloth, but now imitated in cotton goods, which are manufactured to an immense extent in Lancashire, Cheshire, and the western district of Yorkshire. In whatever part of Europe this manufacture was first exercised, it is evident from the name that we derived it from the French; and as it is composed entirely of cotton, its introduction into Britain must be very recent, probably not exceeding 40 or 50 years at the utmost. There are immense varieties of this article manufactured, but the chief are those distinguished by the names corduroy, thicksett, velverett, and velveteen, all of which are merely varieties of pattern in imitation of the Italian and French velvets. In the general article CLOTH MANUFACTURE, a few remarks are introduced relative to the general principles of their fabrication, and a section of them to shew the nature and geometrical principle of the texture, is given in Plate CXCIII. Fig. 10. attached to that article. As an article of common consumption, these goods are found so effectually to combine the desirable requisites of cheapness and durability, as to have brought them into almost universal use with the great body of the people, both at home and abroad, in so far as their exportation is not either prevented or limited by the effects of the war. As the combination of the greatest possible quantity of stuff within the smallest compass is considered as the chief excellence of these goods, they are not paid by any fixed measure of length, but in proportion to the weight by which the cloth when woven exceeds that of the warp when delivered to the weaver, or, in other words, in proportion to the quantity of woof which the weaver is able to interweave with his warp. Thus the weaver is stimulated by his own interest to make the fabric as thick as possible, and this is found to be the best practical plan for procuring goods of this kind sufficiently dense in the fabric. It is, besides, a conclusive proof, that no excess can possibly be apprehended. The ground-work of the fabric is sometimes of plain and sometimes of tweeled cloth. The former being produced somewhat cheaper, is sometimes, although very injudiciously, preferred by poor people; for, from its superiority of strength, the best tweeled fabrics or backs, as they are called, are by very far the cheapest ultimately. The pile being raised in the same way as velvet, is also cut after the web has been taken from the weaver, when the subsequent operations of dyeing and dressing having also been performed, the cloth is ready for the market.

PLATE CXCIII. Fig. 10.

In order to enable those who have not had opportunities of seeing the process of this manufacture, but who may be sufficiently conversant with the practice of weaving other stuffs as to be acquainted with the nature and application of the plans by which the order and succession in which the warp is inserted in the heddles, or healds, of a loom, and the connecting cordage between these and the treddles disposed, a few plans are subjoined of the principal varieties of these articles.

Those who are not previously acquainted with the intention and use of these plans, will find these particulars explained in a future article. For the present it may be sufficient to observe, that the order in which threads of warp through any number of leaves of heddles are drawn, is denoted by the succession of figures or numerals 1, 2, &c.; that the number of treddles is found by the cross checkers at the left hand of the plan, and that those connecting cords which raise a heddle are distinguished by cyphers, while those which sink it are denoted by blanks. The succession of moving the treddles is pointed out by the numerals below. (J. D.)

CORDYLIA, a genus of plants of the class Monadelphia, and order Polyandria. See Botany, p. 272.

CORDYLINE, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 194.

CORDYLOCARPUS, a genus of plants of the class Tetradynamia, and order Siliquosæ. See Botany, p. 262.

COREA, or Korea, a peninsular kingdom of Asia, dependent upon China, called *Kao-li* and sometimes *Chau-tsien* by the Chinese, and *Salho* by the Mantchew Tartars. It reaches from the latitude of 34° 32′ to 43° 10′ both N. and from the longitude of 125° to 131° 34′ both E. from Greenwich, measuring about 500 English miles from N. to S. and 200 of medium breadth from E. to W. so that its area contains about 96,000 square miles, or 62,440,000 statute acres. At one period of its history Corea is said to have contained 690,000 families; which would then give a population of about three millions and a half, or one person to every $17\frac{1}{4}$ acres. On the north it is separated from Maudshuria by a chain of mountains, stretching from E. N. E. to W. S. W. On the north-west from the Chinese province of *Leao-tong*, by a continuation of the same mountain range, and a barrier of palisades or wooden piles. On the west it is separated from China by the gulf of *Leao-tong* and the *Hoang-hay* or Yellow Sea. It is bounded on the east by the Sea of Japan; and is separated on the south-east from the insular kingdom of Japan by the straits of Corea, which are about 86 English miles in breadth, and contain several islands.

The interior geography of this distant peninsula is very little known, as it is inaccessible to European commerce, owing to the jealous precautions of the paramount Chinese government, which limits all foreign intercourse to the port of Canton. It is represented as divided into eight large provinces, containing forty inferior districts, in which there are said to be thirty-three cities of the first class, fifty-eight of the second, and 70 of the third. Its chief rivers are, the *Ya-lou* on the N. W. the *Tou-men* on the N. E. both said to take their rise from a very high mountain, named *Chan-pe-shan* by the Chinese and *Shanelin* by the Mantchews, both names signifying the *ever white mountain*, indicative of its being perpetually covered by snow. There are also the *Li* on the W. and the *Han* on the S. E. besides many other inferior streams on its eastern and western sides. The whole interior of the country is also represented as intersected in various directions by many ranges of hills, dividing it into numerous vallies. *King-ki-tao*, in the central province of *King-ki*, is the capital; and the other principal cities are *Ouei-yuen* in the N. W. *Kiang-si* or Ping-gang in the W. and *Tcin-tcheou* in the S. Several islands are scattered along all the three sides of this peninsula that are washed by the sea, the largest of which, named *Quel-paert* or *Kel-praet*, is on the S. being upwards of forty miles in diameter, and nearly sixty miles from the continent, the intervening sound being studded by a great number of smaller islands.

According to Perouse, the whole southern coast of Corea, from Quel-paert eastwards, until past the S. E. cape of the peninsula, is thickly strewed with dangerous rocks and islands, for the distance of twelve or fifteen miles from the coast; after which, that navigator was able to steer close to the continental shore, being able to distinguish the towns and houses on the coast, and to view the bays as he sailed along. He also mentions having seen many fortifications on the tops of the hills, exactly resembling European forts, probably intended for defending the country against invasion by the Japanese. He reports the eastern coast of Corea to be favourable for navigation, and free from dangers, the sea at three leagues from the coast being every where about sixty fathoms deep, on a bottom of mud. The country appeared every where very mountainous, and the soil seemed arid, and but little susceptible of cultivation. The climate also seemed ungenial, as the snow was not entirely melted in some hollows among the hills in May 1787. A dozen or more junks or sampanes were seen under sail on different parts of the coast, resembling in all respects those in use among the Chinese.

Though mountainous, Corea is said to produce abundance of wheat and rice; and ginseng, a favourite medicine in China, is among its productions. From a species of palm found in this country, a gum or balsam is extracted, of which a yellow varnish is prepared, said to be little inferior in beauty to gilding. It also produces gold, silver, iron, fossil salt, with sables and beaver skins; but the two last are more likely to be only transmitted through Corea, by means of trade or barter, from Maudshuria, and the north of eastern Asia. It has a breed of small horses, only three feet high; and the hens of Corea are said to have tails three feet long, though these are more probably some species of pheasant. The paper of Corea, made of cotton, is in great request in China, for being used, when oiled, in their windows, as it is very strong, and resists the effects of wind and rain. The Chinese also employ it as wrapping paper, and for lining clothes; and from its description, as susceptible of being split into several strong layers, we suspect that it may be manufactured from the bark of some species of plant, in the same manner with what is called Otaheite cloth. Small brushes for painting, made from the tail of some species of wolf, are sent in great numbers to China, where they are said to be much valued. The sea coasts abound with fish of various kinds; and many whales are found every year towards the north-east, some of which are said to have the harpoons of the European whale-fishers sticking in their bodies, and must consequently have come all the way from Greenland through the Arctic Ocean, along the north coast of Asia or America, and by Beering's Straits, into the Seas of Kamtshatka, Jesso, and Japan.

The Coreans are described as stout and well made, of mild and docile dispositions, much addicted to the learning of the Chinese, and fond of music and dancing. They are also brave, and the northern provinces especially produce a stout and active race of men, who make excellent soldiers, using cross-bows and very long sabres. Their houses are generally mean, and consist only of one story; those in the country being constructed of earth, while those in the cities and towns are built of brick, but all are thatched with straw. Their cities are walled after the Chinese manner, having battlements, square towers, and arched gateways. Their dress, writing, religious ceremonies, and most of their laws and customs are borrowed from the Chinese; but their spoken language is entirely different. Their women are subjected to fewer restraints than in China, and the marriages of their young persons are not, as in that country, entirely directed by the will of parents. They do not inter their dead till three years after their decease, on which occasion they place round the tomb or grave the clothes, chariot, and horses of the deceased, and every thing else of which he was particularly fond during his life; all of which are left to be carried away by the assistants at the funeral. They mourn three years for a father or mother, and three months for a brother.

The original natives of Corea were probably of Tartar descent, and are said to have anciently consisted of various tribes, all of which coalesced in the sequel into one kingdom. The history of Corea, as given from Chinese authorities by Du Halde, is altogether unworthy of attention. This kingdom is stated to have been subject to China, no less than 2357 years before the Incarnation, and to have become a separate monarchy under a Chinese prince, named *Ki-tse*, to whom the laws of Corea are attributed, 1122 years before Christ. He is said to have been succeeded by a regular line of independent sovereigns until 264 years before Christ, when the country was again reduced to become tributary to China, and since then it has always followed the fortunes of that empire. About the end of the 16th century, the Japanese invaded Corea, and nearly reduced it to subjection; but were again expelled by the Coreans, assisted by the Mantchew conquerors of China, their over lords. At this time the Mantchews endeavoured to compel the Coreans to shave their heads after their manner, and to adopt the Tartar dress; but this attempted innovation irritated the Coreans, and occasioned a general revolt, which was at length appeased by the prudence of the Chinese government; and the country has ever since enjoyed peace and tranquillity.

The king of Corea is absolute master of all the wealth of his subjects, to all of whom he is universal heir, and the land is distributed among the people in proportion to the size of their respective families, paying tribute in the productions of the soil. Every seventh year, all the males of the several provinces, who are fit to carry arms, are obliged to attend at the capital in succession, doing military duty for two months; so that during this seventh year, the whole male population of the country is in motion and under arms.

On the death of a king of Corea, the emperor of China sends two commissioners of high rank to invest the lineal successor in the dignity of *Que-vang*, or dependent tributary king, who receives the investiture on his knees. On this occasion, the commissioners receive certain regulated presents, together with about 8000 taels in money. After this, the new king sends an ambassador to do homage to the emperor of China, by knocking his forehead on the ground in the imperial presence; and by this person the regulated tribute is conveyed to the treasury; which last ceremony is annually repeated. Even the consort of the king of Corea must not assume the title of queen, till formally permitted by the emperor of China. All the ceremonies and tributes connected with this dependence are so exactly regulated, that no disputes ever arise, and Corea is said to enjoy a perpetual exemption from external and domestic war. See Du Halde and Grosier, *Descriptions of China;* and the *Voyage of Perouse.* (W. K.)

COREGIO. See CORREGIO.

COREOPSIS, a genus of plants of the class Syngenesia, and order Polygamia Frustranea. See BOTANY, p. 307.

CORFU, an island greatly celebrated in ancient and modern history, lies at the mouth of the Adriatic, in 37° 48′ north latitude; and is separated from the mainland of Albania by a strait only two leagues in width, called the Corfu channel, running from north-east to south-west, and obstructed by numerous shoals.

This is a very fine and salubrious island, nearly of a triangular figure, and about 120 miles in circuit. Its greatest length, from Cape Bianco on the south-east, to Cape Sidero on the north-west, is 60 miles, and the greatest breadth, from Cape Palacrum on the east to Cape Barbaro on the west is about 30 miles.

The climate is mild, but exceedingly liable to sudden transitions from heat to cold, which renders it necessary for the inhabitants constantly to defend themselves by such a quantity of clothing as produces a slight and uninterrupted perspiration. These changes arise from the predominant winds, which either passing over the snowy mountains of Epirus on the east, chill the atmosphere, or blowing hot and sultry from the south, arrive charged with fogs. In common with the surrounding countries, Corfu is subject to earthquakes, which are seldom so violent as to occasion much damage. The shocks are said to be always from north-west to south-east; and at different times, buildings have been thrown down. The surface of the island is hilly, with a few patches or plains of level ground interspersed; and the waters which traverse it, are in general inconsiderable streams.

Of late, a small seam of coal has been found in the island, a discovery of the greatest importance, as most of the fuel was brought from the neighbouring continent. Sulphur, of which no other use is made than to kindle fires, occurs in a hill, and near to it is a copious mineral spring, in the middle of a plain, which is resorted to by the inhabitants in the vicinity. Its efficacy proves most sensible, when immediately taken as it flows. There is a quarry of grey marble in the north part of the island, two leagues inland, which, after being long abandoned, was at length worked by an individual, who exported some to Naples. However, this trade was scarcely begun, when the Venetian government took possession of it, and it has been since turned to no account.

Corfu is scantily provided with wood, and what is required for mechanical purposes, is brought from Albania or Venice. Olives, vines, and a few fruit trees, cultivated around the houses, and some oaks and elms, rarely scattered, constitute the whole. From the want of shelter, there is a proportional scarcity of game: birds of passage do not resort to it in equal numbers as to some of the other islands, and when they do come, it is chiefly to shun the cold of Epirus. Wild swans, coots, and other aquatic fowls are abundant, owing to the marshy grounds on the coast: and fish is also plentiful in the surrounding seas. Corfu has, therefore, few sources to maintain a numerous population, as, independent of goats, apparently indigenous, from the milk of which a quantity of cheese is made, all quadrupeds, either for draught, for the saddle, or for subsistence, are brought from the continent.

The total population of the island amounts to 60,000 persons, dispersed in the town of Corfu and 85 villages. About 12,000 dwell in the town, and the villages contain from 150 to 2000 each, besides those in detached cottages and hamlets. It is probable that the population is decreasing, from the want of encouragement to commerce, and the unsettled government of all the Ionian islands. We know that it anciently was an independent power, which could send out fleets and armies, and whose alliance was courted by other states. At present, its political division is into four provinces, of which the largest, called Mezzo, is situated in the center of the island, and the other three, Lefehimo, Agiru, and Oros, lie to the west, east, and north.

Compared with the natural advantages possessed by Corfu, neither agriculture nor commerce are sufficiently extended among its inhabitants, the principal causes of which arise from their invincible repugnance to labour, and, until lately, from the ill judged restraints of the Venetian government. Other sources have been found in the poverty of the peasant; and the territorial property of the island being vested in a few individuals, who, wanting capital themselves, are obliged to obtain it at a great premium, while they have an uncertain return; the surface also, though susceptible of improvement, is not peculiarly adapted either for the plough or the pasturage of heavy cattle. Wheat is chiefly cultivated, which is of excellent quality, and produced in the proportion of seven to one; but the whole that is raised does not exceed two months consumption of the island, and therefore a supply for the other ten months is required. The wealth of Corfu may be said to consist almost solely in olives, and this, in a great measure, from the encouragement long ago held out by the Venetians, who promised a specific reward for the plantation of each tree. The island was soon after entirely covered with olives, and their propagation is still continued; so that, though destitute of woods, numerous copses every where appear. There are now three millions of olive trees on the island, of four different species, the *mirtades*, *glicoglieydes*, *codiglyes*, and *yenoglies*, which last are the most common. The second species produces two kinds of olives, and those of the third, being the largest, are reserved for salting. There are 1080 oil mills, or presses, and the inhabitants are enabled to export annually 300,000 jars, each containing 33 pounds of oil, of a yellow colour, and thick consistence, which, in respect of quality, ranks the fourth in European commerce. The olive tree produces fruit only once in two years; but circumstances are so favourable to its cultivation, that the product of oil might be doubled or even tripled. From a defect of hands necessary to be employed, according to the most approved modes of culture, the inhabitants plead that they are obliged to await the course of nature, instead of seizing those opportunities which might be converted to the best advantage. The mode of extracting the oil is equally imperfect as the treatment of the plant.

A small quantity of wine is likewise made in Corfu, of a deep red colour, and very strong. Principally from mismanagement, and neglect of the vines, the whole does not exceed four months consumpt of the island, which leaves 30,000 casks of 136 pounds each to be imported for use. The care of the vines is superseded by the attention bestowed on the olives, and, as if they were plants of the same nature, both are cultivated but once in two years. When preparing the ground for olives, vines are planted as a secondary object along with them, and when the period of greatest maturity approaches, it commonly becomes necessary to root them out, that the others may be preserved.

In ancient authors we have glowing descriptions of the beautiful gardens of this island, but at present no remains of them are to be found, and horticulture is in as degraded a state as the cultivation of those plants on which the subsistence of mankind materially depends.

A quantity of salt, sufficient for exportation, is procured from three different places, Eftimo, Castrades, and Potamos. It is carried to Albania, from not being so fine as to render it acceptable in Italy; and even in Albania it bears a lower price than what is imported from other places. Gall nuts, and liqueurs in small quantities, are the only other exports from Corfu. All the oil is carried to Venice; the other commodities to Leghorn, Trieste, Ancona, and Constantinople.

It is universally admitted that the island is susceptible of great improvement, and in the hands of a liberal and enlightened government might more than support itself; but instead of being profitable, it proved extremely expensive to the Venetians. The territorial owners of the island, independent of being indebted to the advances of the Jews established in Corfu for enabling them to carry on their agricultural operations, were under the necessity of dealing with commercial connections of the same Jews established in Venice, for the disposal of the produce. Thus they could not be said to have all the advantages of free trade in exporting their staple commodity, burdened with such restriction by the mother country.

The imports to Corfu are equivalent to at least seven months consumption of the year. The inhabitants are totally dependent on other countries for all the larger quadrupeds, for a large supply of grain, and many articles of wearing apparel. Grain from the Morea and Romelia forms the principal import; besides which, 600 horses, 7000 cattle, and 10,000 sheep and calves, are annually brought from the same quarter. Salt fish is imported, in time of peace, from England, Holland, Leghorn, and Genoa; wine from Dalmatia or the Archipelago, woollen and cotton cloths from Trieste and Smyrna, Indian goods from Constantinople. Turkey gains chiefly by the trade of Corfu; nevertheless, the total balance is in favour of the island, as the value of the exports exceeds that of the imports by about one-twelfth.

Almost the whole trade is carried on in foreign bottoms, for the only vessels lately belonging to it were two or three barks, of above 300 tons each, and a few galliots, which visited the neighbouring islands. The inhabitants have so few products of industry to offer to other countries, that it cannot be expected they will soon require additional shipping.

The island is provided with three harbours, or rather roadsteads. That of Gouin, about two leagues from the town of Corfu, is the best, consisting of a bay a mile in diameter, completely land-locked, and with deep water close to the shore. Small quantities of naval stores were always kept in an arsenal there in the time of the Venetians; and, in order to facilitate the communication with Corfu, a rail-way was constructed in the year 1790. The situation is reputed unhealthy, from the neighbourhood of stagnant marshes and salt pits.

The town of Corfu stands on a rock projecting into the sea, and, from the fortifications guarding it, is a place of strength. However, it is commanded from within by a height, called Mount Abraham; but from the sea it is of difficult access, the entrance to the road-stead before it, being protected by two forts, situated on two elevated rocks, and lined by strong batteries. This island being the most important of all the Venetian possessions during several centuries, and having since been a subject of keen contest among the present belligerent powers of Europe, is fortified with more than ordinary care.

About 12,000 inhabitants, half Greeks and half Venetians, dwell in the town, to which may be added the foreign troops by which the island is now occupied. It contains a naval and military hospital, barracks for a number of men, and powder magazines. By an accidental explosion of one of those in the fortifications towards the earlier part of the eighteenth century, not less than 2000 persons were killed and wounded; and by a similar catastrophe in 1789, 600 individuals lost their lives, four galleys and several barks were sunk in the harbour, and many houses in the town severely damaged. The fortresses are completely mined below, and the roads to the gates of some of them are narrow and precipitous.

As the town was the seat of government, it contains a palace for accommodating the proveditore, or governor-general, when the Venetians held it; an archiepiscopal palace, a cathedral, several monasteries, as also a theatre for the amusement of the inhabitants. It appears, that it originally consisted of buildings within a fortress, which guarded a village; and now its suburbs consist of two villages, Manduchio, and Castrades or Castrati, whose inhabitants are of an opposite character. Those of the one follow fishing or commercial employments, while those of the other are prone to piracy and assassination. Pistols and a dagger are commonly part of their costume.

To avert the dreadful ravages of the plague, the islanders have erected a lazaretto in an eligible situation; and we are informed by an eye-witness, of the precautions adopted to prevent the dissemination of that destructive malady. "The government having obtained information, by the declaration of the lieutenant, that a Venetian vessel had arrived with the plague from Alexandria, of which the captain and a sailor had died on the passage, dispatched a galley to intercept all communication with the shore. Some days after, the crew, with their whole effects, were carried to the lazaretto, where shirts impregnated with tar were substituted for their own clothes, and they bathed twice daily in presence of the health officers. Four nevertheless died, whose bodies were thrown into a deep pit dug by their comrades, and covered with quick-lime, while every thing pertaining to them was burnt. The vessel, after having been completely unloaded, was sunk during twenty days, and then being weighed, no person was permitted to go on board during eight days longer. The crew were now embarked, and five galley-slaves were allowed to join them in place of those deceased. They sailed for Venice under convoy of a frigate, which never lost sight of them until arriving at that port, where they had to undergo a new quarantine for eighty-two days more." By such rigid precautions, the plague is seldom introduced into the island.

From what has before been said, it might be supposed, that the Corfiotes are a rude and impoverished people. But it is by no means so, for a large portion of them are in a state of refinement little inferior to that part of the European continent on which they are dependent, and comfortable subsistence is enjoyed by most of the others.

The mass of the public, for want of seminaries, receive no instruction to improve their youth; and the education of women, excepting what is slenderly bestowed in convents, is altogether neglected. Law and physic were lately held in greater repute; and those who professed them, gained their knowledge at the Italian universities. Learned men, however, have appeared in the island: Collections of manuscripts have been formed in the town, and likewise of antiques, and other matters of curiosity. An academy for the illustration of scientific and literary subjects, was founded here in the seventeenth century; which had but a transient subsistence. Many of the clergy, particularly of the lower orders, are in such a deplorable state of ignorance, that it is said they can scarcely write or read; and in the recitation of prayers learned by rote, they will use as an invocation for rain, that which is designed to implore restoration of the serenity of the heavens.

The ecclesiastical establishment is of a mixed nature, being partly according to the Greek, and partly according to the Roman Catholic rites. The latter were followed by the members of the government, and the military and marine forces, under the Venetians. An archbishop named by the senate was appointed by the pope, and, on his arrival, was received with both ecclesiastical and military honours. In ceremonious entertainments he was served on gold. This establishment comprises the cathedral, two churches, a chapel, and three convents of the order of St Francis.

The greater part of the population follow the Greek church, at the head of which is a protopapa, or chief priest, chosen by an assembly of the clergy and noblesse. He is always of a noble family, distinguished from the chief priests of the other Ionian islands by the title of great protopapa, and is invested with episcopal powers. This place is obtained by the candidate and his friends using private interest with the electors; and bribes are sometimes not unsuccessfully employed on the occasion. Immediately on election, the protopapa gives an elegant and expensive entertainment to the higher order of islanders, who do not scruple, after satisfying their appetite, to carry away part of the feast; pieces of money are thrown to the populace, and a tumult of rejoicing prevails. A cathedral, several churches, and some convents, both of monks and nuns, are under the rule of the protopapa. He remains five years in office, and then returns to the ordinary class of papas, retaining nothing but some slight external decorations as a badge of his former greatness.

Among the manners of the Corfiotes, we find some remarkable instances of weakness and superstition; indeed, the most prominent features of their character are vanity and credulity. One principal source of the revenues of the Greek church arises from excommunications. Any individual may, on the slightest pretext, obtain the excommunication of his neighbour, who is thenceforward utterly excluded from the

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protection and privileges of the church—a punishment equally dreaded as the severest corporal pain. Should the protopapa receive a sufficient pecuniary inducement, he will himself pronounce the anathema, by repairing before the house of the person at the head of his clergy, all habited in black, and preceded by a great crucifix with a black flag. The object of vengeance, however, can render the excommunication altogether nugatory, and be restored against its effects by obtaining a counter-excommunication, which is attended with no difficulty, and the same priest is wont to be alike zealous in the service of both. But the ceremony being expensive, the denounced sometimes retaliates by assassinating his enemy. Availing themselves of such an engine, the Venetian government has been known to obtain the excommunication of whole villages, where it was impolitic to use a military force; all intercourse between the inhabitants and their neighbours was by that means cut off, and they were soon glad to testify their submission. The people at large witness these excommunications with uncommon awe: they firmly believe that the earth trembles at the moment the anathema is pronounced, and they utter loud cries of terror.

Marriage in Corfu are celebrated according to the Greek ritual, and attended with various allegorical ceremonies. A table is prepared in the best apartment, on which the Bible is laid between two wax tapers; there is also on a salver at one side, a glass or small phial of wine and a little bread; and on another salver, at the opposite side, garlands of rose-coloured ribbands. When the ceremony is finished, a crown is made by interlacing the two tapers, which is placed above the nuptial bed, to figure the union perpetually to subsist between the spouses. The wife, by established custom, is then seen dissolved in tears, to testify her regret at quitting the virgin state. But the husband has to dread the malevolence of those who envy his approaching felicity; and if, at the moment of consent, any byestander shall cast three knots on a cord and throw it in the fire, it is confidently believed that he will thenceforward be completely enervated. This species of incantation, by knotting a cord, has been known even in our own country; and records, not of a very ancient date, preserve the confessions of some unhappy wretches condemned to the flames, acknowledging its purport in the most unequivocal language. However, it is not void of remedy in Corfu, for the husband, by placing a pistol, which has served for several assassinations, under his pillow, will break the charm. Should he not be completely satisfied of his wife's integrity before the marriage, he can return her to her relations, which is the greatest misfortune to which she can be exposed, as she thereby loses all consideration among her companions.

Unlike that reluctance to part with a favoured object which is felt over all the world, preparations for interment are instantly made when a person expires in Corfu, and two hours scarcely elapse before the body is committed to the earth. Meantime it is clothed in the best apparel which it wore during life, and enveloped in such a way as to leave nothing but the head and hands exposed. Thus clothed, it is laid on tressels covered with a crimson carpet, with a cushion under the head, and a crucifix between the hands: and if the person was unmarried, the body is crowned with artificial flowers. Great lamentations follow, in the course of which are heard eulogiums on the deceased, intermingled with regrets for hisl oss; the body is next carried forth to the church, where the religious part of the ceremony is performed. When this is finished, all the friends kiss the deceased, at the same time uttering something in a low whisper; and it is thought a mark of great respect to a stranger, which he cannot easily refuse, to invite him to pay the like tribute of regard. The dead are interred within the churches, excepting those of the lowest order, who are deposited in a small adjoining cemetery. Every three months, wine, oil, and bread, are brought to the grave, and the deceased is called on, with loud lamentations, to partake of the repast, in which the priests officiating in the church are accustomed to devour when there is no hazard of detection. Mourning consists of apparel universally black, which is extended even to the linen, and all care of their person is entirely neglected. For the nearest relations it continues a year; and sometimes, by a disgusting practice, the linen is never changed during the whole period.

From the change of masters which Corfu has so repeatedly undergone of late, it is unnecessary for us to detail the forms of government that have prevailed. But we may observe, that this being reckoned the principal of the Venetian islands, to which all the others were held subordinate, it was provided with a governor, or *proveditore generalé*; who was frequently a senator. He was assisted by several other persons, some appointed by the senate, others by himself; and his nomination commonly took place a year before his predecessor went out of office. Much state was attached to the situation, and the proveditore annually gave entertainments of ceremony to the clergy, the Venetian noblesse, the military, the Corfiote noblesse, and the commons. By a strange fashion, these entertainments, amidst the appearance of splendour, were a source of profit, for the islanders made abundant supplies for them; and of many present, each according to custom, adroitly slipped an *oil draught* under his own plate. By this the donor drew on himself for a certain quantity of oil from the first harvest, payable either in kind or by an equivalent in money. All the draughts were collected by an aide-de-camp, and put into the hands of the proveditore, who entrusted one of the nobles of the country with levying the amount on becoming due. The proveditore every year made a voyage among the other islands, purposely to examine what contributions could be obtained from them. His secretary took charge of the inquisitorial proceedings which emanated from this institution at Venice; and he himself, as sovereign administrator of justice, decided on the lives and fortunes of the islanders, though his sentence might be reviewed by different tribunals. Means were too easily found to evade the punishment due to crimes; but when once a culprit was condemned, he was, during twenty-four hours preceding execution, chained to a post in the corner of a chapel. In the middle of it was a large stone table, whither he was conducted to partake of a sumptuous repast, served by the domestics of the governor in their richest livery. The repast finished, he was again put in chains, and remained there until led forth, accompanied by a procession of penitents to punishment.

The inhabitants of Corfu pique themselves on their illustrious descent, and many claim an origin from the ancient Greeks and Romans. There are two kinds of noblesse. One, it appears, could be created by a council of nobles, but not unless the family of some individual had become extinct; the dignity of the other flowed from the Venetian government. In the former case, it was necessary that the elect possessed a certain re-

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venue, and that no profession or mechanical pursuit had been exercised by his family for three generations. He passed five years of probation without being admitted to the council, and only after the lapse of ten years did he participate in all the privileges. Each year 150 nobles were chosen from a general assembly of the whole, to constitute a council, from which the subordinate magisterial functionaries requisite in the island should derive their appointments.

There are besides a number of Venetian nobles resident in Corfu, an alliance with whom is highly esteemed by the islanders. It has been a special means of promoting civilization and luxury, for the manners of the parent state are thereby incorporated with the colony. Formerly, the females of the island were kept under the greatest restraint: confined within lofty walls and grated windows, they saw none but their nearest relatives; their subordination to their husbands was absolute; they were employed in menial offices about them, and deemed themselves happy in being admitted to their tables.

The vanity and ostentation of the Corfiotes lead them to spend on their persons what should otherwise be spared for the support of their families; and a citizen, to indulge his love of show on public occasions, will be well content to pass a considerable time in subsequent penury. Possessing few opportunities of bettering their fortunes, such practices cannot fail to prove inimical to domestic comfort.

The amusements of the people are either sacred or profane; for nothing is converted to a greater source of entertainment than religious processions. To these they are peculiarly addicted, and their clergy are not slow in exhibiting what is a powerful method of extending their own influence. The festival of St Spiridion, the tutelar saint of the island, is celebrated with particular pomp: Many days are occupied in preparations for it; and when the shrine borne from the cathedral reaches the fortifications, it is received with a salute of 21 pieces of cannon, and the same honours are paid by the shipping in the roads, amidst the ringing of bells and the repeated discharges of musketry. Contrary to any other example with which we are acquainted, the body of this saint does not belong to the public at large, but is the property of a private family named *Bulgari*, and is the source of considerable wealth. One instance occurs in history, where, instead of a pecuniary dower, the body of St Spiridion was given along with a daughter of the family in marriage.

The night of Holy Thursday is especially devoted to processions: each church and each chapel has its own, and a kind of emulation for excellence prevails among the respective devotees. All unite on an esplanade, the streets are crowded, and the blaze of innumerable tapers rivals the light of day. The resurrection of Lazarus depicted on a flag, is carried about the city on other festivals, by a person dressed in the most grotesque manner, who sings the event in modern Greek verses, and occasionally performs a lively dance to a pipe and tabor. Devotees are permitted to kiss the banner on paying some pieces of money. That the superstitions of the people are very gross, appears from a singular custom practised on the night of Holy Thursday. A number of girls, all named Mary, are employed to make a shirt, which is believed to render the wearer invulnerable. But that it may possess this property in its full extent, it is essential that the number of girls be unequal; that the work be commenced after midnight, and completed before break of day.

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Corfu has long possessed a theatre, where at first men were the only performers, and to which none but men resorted; neither were there females among the *dramatis personæ*. Married women were afterwards permitted to share in the amusement, but the boxes devoted to their accommodation were latticed in front, whereby a full view of the scenery was intercepted; a decisive proof of the remnants of eastern jealousy. To shun this inconvenience, they consented to appear masked, but the mask was gradually laid aside, and of late years their attendance is unrestrained. It is a point of etiquette to pay and receive visits in the theatre; and the charge of procuring a suitable company of performers devolved on one of the Venetian generals, who was stiled *Preside del Teatro*. During the carnival, the governor-general and principal Venetian nobles and officers never appeared unmasked; but no islander durst wear the colour adopted for their costume, nay it was the exclusive privilege of the first to use crimson velvet in the furniture of his palace. Multitudes flock from the country to behold the diversified spectacle now exhibited, and to witness the singular and ridiculous disguises displayed on the occasion. The most brilliant part of the show, is a kind of tournament, or running at the ring, resembling what was practised of old, devised or revived by a military officer, about the termination of the sixteenth century, who was killed on the first encounter. One of the broadest streets is prepared for this exercise called *Chiostra Publica*, on each side of which are erected amphitheatres for accommodating the spectators. The competitors appear splendidly attired, and mounted on horses with the richest housings; they first break a lance on a wooden figure, and next try to carry off on its point a small ring suspended across the street. Each horseman follows at full speed in his turn; and the ring must be three times borne away to entitle the victor to the prize. But the nobles alone can contend for it. An inferior description of the same amusement is provided for artizans and merchants, when the victor is accompanied home with the beating of drums.

Corfu has from time immemorial preserved an importance to which its present territorial extent does not seem to entitle it. Some philosophers have conjectured, that convulsions of the globe have reduced its size, by severing its neighbouring dependencies from its shores; and there is much probability that the population was once more numerous. It has been alike famed in mythology and in profane history; and known by the names of Drepanum, Macris, Scheria, Corcyra, and Corfu. Both Horace and Virgil make it the resort of their fabulous heroes, and we know that it received Aristotle, as well as his illustrious pupil, Alexander the Great.

This island was successively subject to the Greeks and Romans; a fact which, independent of written history, is proved by medals and inscriptions frequently discovered. When Italy was over-run by the barbarians, Corfu suffered universal pillage; and under the emperors of the East, participated in the different contests for dominion. At a later period, when Charles King of Naples approached its shores with the design of conquest, the evils of war were averted by voluntary submission. But having thrown off the Neapolitan yoke, it experienced an attack from the Genoese, who succeeded in taking the chief towns, though they were ultimately expelled. However, the apprehensions of the inhabitants were so much excited for a renewal of the attack, that they implored the aid of the Venetians, and in doing so, committed the island to their administration. The Genoese returned, and were again repulsed. A more formidable enemy now appeared in the Turks, who, under the famous Barbarossa, had before unsuccessfully invaded the island. In the beginning of the 18th century, a powerful army, aided by a large train of artillery, invested the capital; but after a brave defence by Count Sculembourg, the commander, they were forced to retire with the loss of 15,000 men and 64 pieces of cannon. The Venetian government shewed their gratitude to this officer, by erecting a white marble statue of him, with an appropriate inscription, during his life; an honour which few have enjoyed.

Some time after the French began to disturb the tranquillity of Europe, they made themselves masters of Corfu, towards the latter end of the last century, and were allowed to retain it by the treaty of Campo Formio in 1797. The fifth article of that treaty declares, that "his majesty the Emperor, King of Hungary and Bohemia, consents that the French republic shall possess in full sovereignty the Venetian islands of the Levant, viz. *Corfu*, Zante, Cephalonia, Santa Maura, Cerigo, and other islands their dependencies; as well as Butrinto, L'Arta, Vonissa, and in general all the former Venetian establishments in Albania, situated lower than the Gulf of Lodrino."

Corfu has ever since been the theatre of warfare: it was taken by the Russians, and then by the French, in whose possession it still remains. Not long ago, a convoy with provisions destined for supplying the garrison, was captured or dispersed by some British ships of war. See Marmora *Istoria di Corfu.* Quirini *Primordia Corcyræ.* Spon et Wheler *Voyage*, tom. i. Olivier *Voyage*, tom. iii. Scrofani *Voyages*, tom. i. iii. (*c*)

CORIANDRUM, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 165.

CORIARIA, a genus of plants of the class Diœcia, and order Decandria. See BOTANY, p. 337.

CORINTH, was a small dynasty of Greece, bounded on the east by the gulf of Saron; on the south, by the kingdom of Argos; on the west, by Sicyon; and on the north, by the isthmus and bay of Corinth, the latter of which is now called the Golfo de Lepanto. The capital of this territory, which bore the same name with the territory itself, was situated about the middle of the isthmus, at about the distance of sixty stadia from the sea on either side. It is said to have been founded by Sisyphus, the son of Æolus; but, at first, it was denominated Ephyre, an appellation which the ancient annalists derive from a lady of that name, who was the daughter either of Oceanus and Tethys, or of Epimetheus and Myrmex. Corinthus, who, by different authors, is said to be the son of Jupiter, or of Marathon, or of Pelops, afterwards rebuilt and adorned the city, and from him it received the name by which it is chiefly known in ancient history, and has descended to our day. The only other cities of any magnitude, in this country, were Cenchrea, situated on the bay of Saron; and Lecheum, on that of Corinth; and as these possessed excellent harbours, at no great distance from the capital, and having an easy access both to the Ægean and Ionian seas, they became the greatest emporiums of trade of any places in Greece. As the whole region was mountainous and rather barren, the inhabitants were not much addicted to agriculture; but from their local situation, they possessed singular advantages for commerce, which they carried on to a great extent. The natural consequences of an extensive commerce were wealth and luxury: fostered in this manner, the city rose in magnitude and grandeur; and the elegant and magnificent temples, palaces, theatres, and other public buildings, adorned with statues, columns, capitals, and bases, not only rendered it the pride of its inhabitants, and the admiration of strangers, but gave rise to that order of architecture which still bears its name. Besides the citadel, built upon a mountain, which overlooked the city, called Acrocorinthium, the works of art which chiefly displayed the opulence and taste of this people, were, the grottos, raised over the fountain Pyrene, sacred to the muses, and constructed of white marble. The theatre and stadium, built of the same materials, and decorated in the most magnificent manner. The temple of Neptune, containing the chariots of that god, and of Amphitrite, drawn by horses covered over with gold, and adorned with ivory hoofs. The avenue which led to this edifice, decorated on the one side with the statues of those who had been victorious at the Isthmian games, and on the other with rows of tall pine trees. Though the arts of architecture and of sculpture were carried to a great height, yet, in a city abounding with trade and luxury, the sciences did not take a deep root, nor were they enabled to attain maturity. Even the art of war, which their situation, commanding both seas, and separating, by the isthmus, the one half of Greece from the other, gave them great advantages for prosecuting, was never resorted to for purposes of ambition, but only for defence; and it was their wealth more than their valour that gave them any influence amongst their neighbours. But though their genius was not warlike, yet they cultivated peace, not from indolence or pusillanimity, but from a wise estimate of the blessings which it confers; and hence they knew to value and to defend their liberty and independence, which they never yielded either to internal despotism, or to external force; and from amongst them arose some of the foremost candidates for military renown, who not only defended their own territories, but were courted by the neighbouring states to lead their armies to fame and victory. We are sorry to add, that their religion, which was a species of the most licentious idolatry, cherished, instead of checking, the appetites and passions of its votaries; and that the statute which enjoined the temple of Venus to contain a thousand prostitutes, was not the most disgraceful of their civil and religious institutions.

The exploits of Sisyphus, which have descended to our day, like those of all the heroes whom we meet amidst the mists of antiquity, are few and insulated. After laying the foundations of Corinth, his life was disgraced by rapacity and debauchery, which however were not so much the vices of the man as of the age. Prompted, at last, by the ambition of extending the boundaries of his dominions, he invaded the territories of Attica, and fell by the hand of Theseus who then governed that kingdom. Nor did the vengeance of heaven pursue him in this world only. On account of his crimes, if we believe the fabulous muse of Greece, Sisyphus is doomed, in hell, to roll a large stone to the top of a mountain, which, when it has reached the summit, bounds backward with accelerated impetuosity, and again invites him to renew his hopeless labour.

He was succeeded by Glaucus, his son, by Merope the daughter of Atlas. This prince, whom Euripides calls Creon, received, and hospitably entertained Jason and his wife Medea, when expelled from Thessaly by Acastus; but when he gave his daughter Glauce in marriage to the exiled monarch, Medea was so enraged at the perfidy of her husband, that she murdered her children, burnt her palace to the ground, and fled to Athens. It is said, that Glaucus, to increase the swiftness of his mares, precluded them from all intercourse with the males; and that Venus, enraged at this indignity offered to her authority, inspired the mares with such fury, that they tore their master to pieces when returning from the celebration of some funeral games.

He is said by some to have been succeeded by his son Bellerophon, who received that name from the murder of his brother Beller, for which he was expelled to Argos; but it is more probable that Bellerophon was expelled during the life of his father, and that at his death, Ornytion, a younger son, ascended the throne. From him the sceptre descended through a long line of descendants for upwards of 400 years; but as their names are associated neither with the history nor poetry of Greece, we shall suffer them to remain unnoticed. It is said by some that the last of the race died childless; but by others, that the supreme power came into the hands of two brothers, Doridas and Hyanthidas, who were forced to resign the sovereignty by Aletes, one of the descendants of Hercules, who ascended the throne. The kings of the same family who succeeded him, proud of their origin from that hero, called themselves Heraclidæ, to the fifth generation; when Bacchis ascending the throne, changed the family name, of which his ancestors boasted, into that of Bacchiadæ, derived from his own, and under that appellation his posterity swayed the sceptre of Corinth for about 400 years. From Archias, one of these kings, Syracuse the metropolis of Sicily derived its origin; and about the same period, in order to carry on their commerce with distant countries, the Corinthians invented those ships which, from their peculiar construction, were called *triremes*.

Telestes, the last of the family of the Bacchiadæ, was only in his infancy when his father Aristomedes died. His uncle, Agemon, who at first governed the kingdom in the name of his nephew, soon usurped the sovereign power which he exercised during sixteen years. He was succeeded by his son Alexander, who, after reigning 26 years, was killed by Telestes, who at that period asserted his right to the crown, and succeeded in the enterprise. He, however, abused the power which his valour had gained; and in the twelfth year of his reign he was deprived of his life by two of his own kindred.

At his death, 200 of the principal Bacchiadæ assumed the government, which now became aristocratical, united under one of their own body, whom they chose as president, and who bore the name of Prytanis. In this manner was Corinth governed for about 240 years, when Cypselus, one of the Bacchiadæ, prompted by the response of an oracle, formed the ambitious design of subverting the power of the aristocracy, and placing himself upon the throne. His wisdom and valour accomplished his design, and having reigned thirty years, he died and resigned the sceptre into the hand of his son Periander. This prince, at the beginning of his reign, gained the affection of his subjects by his moderation and justice; but forgetting the virtue and happiness which he then practised and enjoyed, he became by degrees a tyrant, equally an enemy to the peace of his family, and the prosperity of his kingdom. After having murdered many of the nobles of Corinth, committed incest with his own mother, put to death his wife Melissa, and banished his son Lycophron for weeping over the ruins of his family, he died, and, by the meanness and ignorance of a barbarous age, was enrolled amongst the seven sages of Greece, because in the midst of his cruelties and debaucheries, he had paid some attention to learning and its votaries.

We should willingly have adverted to some of the memorable revolutions which afterwards happened to this country, but as the limits prescribed to us will not admit of it, and as, from this period, the history of Corinth becomes identified with the history of Greece, of which it may now be considered as a province, we must refer our readers to that article for an unbroken narration of its future history. (N)

CORINTHIAN Order. See Civil Architecture.

CORIOLANUS. See Rome.

CORIS, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 136.

CORISPERMUM, a genus of plants of the class Monandria, and order Digynia. See Botany, p. 83.

CORK, a well known substance in very general use, is the exterior bark of a tree of the oak genus, the *Quercus Suber* of botanists, which is indigenous in the southern parts of Europe and Asia Minor, and is abundant in the south of France, Spain, Portugal, and Italy. The cork trees are fit to be stripped of their exterior bark at fifteen years old; but, while young, this operation ought not to be repeated till after an interval of three years. Older trees may be safely barked for eight successive years, and should then be allowed to rest for two or three years. If not stripped artificially, this outer cork-bark splits and peels off naturally, in consequence of a new growth forming annually under that of the preceding year. The quality of this useful substance improves with the age of the tree.

It is taken off in sheets or tables of considerable size, from the entire stem or body of the tree; being cut circularly at top and bottom, and also perpendicularly in portions of convenient size, and then peeled off by means of a knife, resembling a hay spade, and similarly used. Or, after the circular and perpendicular incisions are made, which cut off the connection of the cork from being nourished by the parent tree, it is left for some time to loosen from the under bark, when its separation is easily effected by the hand. After its separation from the tree, the Portuguese, who chiefly supply Britain with this commodity, prepare it for sale by reducing its cylindrical curvature nearly to a flat in the following manner. It is piled up in ponds or ditches, with the hollow side undermost, and loaded heavily with stones; and this operation is afterwards more completely effected in a damp cellar, by which means it becomes nearly flat. This is called *laying* the cork; and it is afterwards dried completely over a strong fire, which operation is called *burning* the cork. Some persons satisfy themselves with this single operation, in which the convex side of the cork is laid to the fire, and continued over it till it becomes flat. From negligence in this process, the article often receives too much heat, which gives the blackness so frequently seen in articles made of cork. When sufficiently flattened, by being *burnt* or roasted rather on its back, the other side also is subjected to the operation of the fire, so that both surfaces are partially charred: and though this operation is sometimes carried too far by the Portuguese, it is also sometimes not sufficiently performed, as our cork-cutters have often to repeat it in this country before it is fit for their use. During this operation of burning, the Portuguese peasants are careful to cover up all holes or crevices, by the artful introduction of soot and dirt. Be-

Cork. sides flattening the pieces of bark, this operation closes up the pores of the cork, by occasioning it to contract, and greatly lessens its sponginess and open texture, which would otherwise render it a filter, especially in what are called taps and bungs, which are cut perpendicularly to the natural surfaces. After the operation of burning, the cork is built up into stacks, till purchased by the merchants or their agents for exportation.

The principal use of cork in the present day is for making stoppers to bottles that are to contain liquids which are not of a corrosive nature; for which purpose it serves admirably, as it is easily compressed by pressure, expands readily by its elasticity, fills and stops very closely the space into which it has been forced, does not communicate any disagreeable taste or flavour to the liquors which it retains, and does not allow any watery or vinous liquor to escape. This substance is also used as *taps* and *bungs* for casks, is made into inner soles for shoes, floats for fishing nets, artificial legs and arms for those who have suffered amputation, and a variety of other useful articles. It is also used in the construction of Mr Greathead's boat, for preserving the lives of seamen in danger of perishing by shipwreck,—a late admirable invention, for a particular account of which see LIFE-BOAT. Owing to its elasticity, it is also used for many other useful purposes, such as the spring of the lifter in ordinary candlesticks, and has been recommended as a good substitute for weights and pulleys for holding up light window-sashes. Cork is also used in Spain and Portugal for lining stone-walls in particular places, rendering the apartments very warm and dry; and is also employed for lining the sides of ships of war, to prevent splinters in time of action. Besides these uses of cork, it is made into what are called *cork jackets*, for preserving the lives of persons in danger of drowning. For this purpose, pieces of cork, about three inches long and two wide, and the entire thickness of the bark, are inclosed between two pieces of strong linen or canvas, made in form of a jacket without sleeves, and sewed round each piece to keep them all in their proper places, the lower edge of the jacket, about the hips, being left in loose flaps, like the under part of stays, to leave freedom to the thighs in swimming.

This substance, as imported, is seldom sufficiently flattened or dried for being used by our cork-cutters, who accordingly have to render the process of *laying*, or *burning* rather, more complete, by roasting it again over a fire, which is generally made of cork shavings or cuttings, under a sparred iron frame standing on four legs of convenient height. In this new operation, the convex side of the slips are laid next the flame, when the heat counteracts the natural bend, and reduces the cork to sufficient flatness, while at the same time it renders the substance more compact, and sufficiently dry to admit of being easily and accurately cut. It is afterwards cut into narrow or wide slips, according to the particular purposes for which it is to be applied, as corks, bungs or taps, and these slips are afterwards cut into squares, proportional to the uses they are intended for. The squares intended for corks, are sorted into three denominations, *short*, *short-long*, and *full-long*; and, as the bark is not of the same quality throughout each piece, the finished corks are finally sorted by a boy into four kinds, *superfine* or *velvets*, *fine*, *common*, and *coarse*, and are sold at proportional prices. The only tool used by the cork-cutter in forming the corks, is a broad, thin, and sharp-edged knife, with which he adroitly pares the squares into cylinders, or rather slightly tapering frustums of cones, after which he pares off the top and bottom quite level, and throws the finished cork into boxes or baskets for receiving corks of the same length. The parings are saved, to be afterwards sold to colour-makers, for being charred into what is called Spanish black.

Some other productions of the vegetable kingdom have also been occasionally used for similar purposes, as possessing properties similar to those of cork; such as the exterior bark of the *Spondias lutea*, Mombin, or Jamaica plum, which is sometimes brought over as a substitute for cork. The bark also of a North American tree called Myssa, has been applied to similar purposes. Liquorice roots are sometimes also used in the same manner.

Cork was certainly known to the Greeks, under the name of Φελλὸς, and Theophrastus describes the tree as a species of oak having a thick fleshy bark, that requires to be stripped off once in three years, to prevent it from perishing. He mentions also its great levity, so as never to sink in water, from which quality it might be applied to a variety of useful purposes. The *Suber* also of the Romans was evidently the same substance with our cork, as Pliny describes it in the same terms used by Theophrastus respecting φελλὸς. It was applied by the Romans to many useful purposes; particularly as floats for nets, and as buoys for anchors, under the name of *anchoralia*. They also employed it for soles to their shoes or sandals, to keep their feet dry, and for making their ladies appear taller. Pliny also mentions its use for stopping vessels of all kinds; but its more universal employment for bottles is entirely of modern invention, as glass bottles do not appear to have been introduced, at least into general use, before the fifteenth century. The ancient Egyptians also employed cork in the construction of coffins, which were coated within with a resinous substance. The use of cork, for enabling persons to swim, and to preserve from drowning, was very early known to the Romans; as the messenger sent by Camillus to the capital, when besieged by the Gauls, took cork with him under his light garments, to enable him to swim across the Tiber with safety.

The bark and acorn of the cork tree, charred and reduced to fine powder, have both been considered as astringents, externally applied, but are probably mere inert charcoal. Cups made of cork have even been recommended for the use of hectic persons. The chemical properties of cork have been already treated under the article CHEMISTRY. (W. K.)

CORK, a county of Ireland, situated in the province of Munster. It is bounded by the county of Waterford on the east; that of Kerry on the west; those of Limerick and Tipperary on the north; and by the Atlantic Ocean on the south. Both in extent and population it is by far the largest in the island, containing in these respects, according to Dr Beaufort, about a tenth part of the whole

Boundaries.

This county affords great abundance and variety of scenery. With an extensive range of bold and rugged sea-coast—some large rivers, and many smaller streams—mountains and hills of various height and aspect—plantations of thriving wood—corn fields, and walks of sheep and cattle—towns, villages, and hamlets—and a multitude of family seats, belonging to noblemen and gentlemen of fortune—it offers to the traveller's eye every diversity of grand and beautiful, of rich and barren, prospect. Indeed, some parts of it, particularly Glengariff, in the

Scenery.

Cork.

neighbourhood of Bantry Bay, are said to possess so much of the romantic, the pleasing, and the sublime, as to rival Killarney itself, which is usually and justly celebrated as one of the finest spots in the united empire. Mr Wakefield recommends this part of Ireland, in the language of enthusiasm, to the attention of every one who seeks for nature in her most favoured retreats.

Water-fall.

At Hungry-hill, not far from Ross-Mac-Owen, there is one of the finest water-falls in Europe. Hungry-hill is a high, rocky, and almost perpendicular mountain, not less than 2000 feet above the level of the sea, on the top of which a large lake is collected from several small rivulets and springs. The water falls from that height in a sheet at least thirty feet broad, which grows wider as it descends. When half-way down, it dashes on a projecting rock, raising a mist which covers almost a third part of the hill, and which, in certain circumstances, exhibits the phenomena of the rainbow. It afterwards falls from rock to rock, till it has passed the more rugged declivities of the mountain; and before it reaches the ocean, it falls over a lower hill, in the form of a beautiful arched cascade. There being very little water here during the summer months, this fall is seen to most advantage in winter and in rainy seasons.

Climate.

The climate of this county is mild and favourable. It is exempted from the extremes of heat and cold. Cattle, in general, are never housed, even on the mountains, and yet thrive well. Geraniums, myrtles, and exotics of every kind, may remain out of doors the whole year, without suffering injury, provided they be placed in a southern aspect, and screened from the cold northerly and easterly winds by some bank or rock. In more sheltered situations, the deciduous trees are stripped of their foliage only for a very short time. Wet weather is prevalent in the south-west parts of the county. But as the sub-stratum of the soil is in general dry, the moisture is seldom more than sufficient to carry on the vegetation. From a regular diary of the weather, kept for several years in the city of Cork, it appears that the wind blows from the south to the north-west, at least three-fourths of the year. In the course of thirteen years, the barometer had ascended once to 30.4 inches, and in that time its lowest height was 28.2. The average quantity of rain, which fell from the year 1738 to the year 1748 inclusive, was 38.26 inches. The mean temperature in different parts of the city, in 1788, was from 52° 5′ to 53° 5′, which was about 2° higher than it was in Dublin during the same year, and about 4° higher than in Londonderry. The mean temperature, in that year, of the coast to the south of the city of Cork, as observed by means of deep covered wells, in limestone and other soils, was 51° 2′. Mr Wakefield was at Glengariff, west of Bantry, in the last week of October 1808, and, at that late season, he found the temperature as mild as it is in England in the first week of June.

Agriculture.

On the agricultural state of Cork much praise cannot be bestowed. It enjoys many advantages, both of soil and climate, and maritime situation; but these are sadly counteracted by other circumstances of a most unfavourable kind. Independently of that general depression under which the people labour, and which must always be hostile to improvement of every kind, there is here a very imperfect system of husbandry, immediately proceeding, no doubt, from the want of skill and capital on the part of the farmers, but as certainly perpetuated by a want of that exertion and liberality which, in such a case, should be displayed on the part of the landholders. The evil must be traced, also, in a great measure, to the practice so prevalent in Ireland, of the great proprietors going to distant places to spend their time and fortune; thus withdrawing that personal influence which might be so useful at home, where it is so much needed, and leaving their tenants to be oppressed, and their estates to be mismanaged in their absence. From this injurious treatment, Cork is by no means exempted, though, at the same time, it must be observed, that in few counties are there to be found such a proportion of respectable residents. Amidst all these discouragements, however, the agriculture of this county has made considerable progress in some districts; it is still advancing, though by very slow degrees; and were the obstructions and difficulties, with which it has still to struggle, effectually removed, there are few places where it could proceed with a more rapid pace, or with more certain success. A Farmer's Society has been established at Cork, and gives premiums for the best ploughs, oxen, pigs, &c.

Aspect.

The county is in general hilly. Very little of it can with propriety be called flat, and the whole of the south-west part is formed by a ridge of mountains, which rises to a considerable height, and extends into the sea. Most of its western side is rough and uneven, but not so much so as to prevent it from being subjected to the plough.

Soil.

It contains great tracts of poor and barren land, particularly in the barony of Ban and Bantry, and in the western parts of Carbery and Muskerry, in which the Sheely mountains are situated. A great proportion of the mountainous land is either naturally so wretched in soil, or has been so little attended to, where it is susceptible of improvement, that it is not, in fact, worth threepence an acre. And even the flat hills, which are situated at a distance from towns, bring a very low rent. Those, indeed, which are in the neighbourhood of large towns, are more valuable. Some of them are cultivated almost to the summit, and are tolerably productive. But they form only a small proportion of the whole, one part of which is absolutely sterile, and the other almost wholly neglected. At the same time, there are not wanting individuals, who have done much to bring the latter into as productive a state as possible. Of these attempts, a gratifying account is given by Mr Townsend. The good land in this county, however, predominates; and while, in many places, its quality is excellent, in some also it has been brought to a high pitch of cultivation. This is to be seen especially in the vicinity of the Blackwater, and in the barony of Innskilly. The south-west and northern parts have been much neglected; they are however very capable of improvement.

Crops.

In the southern districts a great quantity of different kinds of grain is produced on the whole; though the individual quantities are small, in consequence of the land being much divided. In Donneraile, and other places, a considerable quantity of wheat is raised, but the crops are seldom or never abundant. Indeed Mr Townsend, in his Survey, makes this general remark, that the acreable wheat produce of the county is not great. To the south of Cork city this grain forms a regular part of the rotation of crops—a circumstance by no means common, and which was introduced there by the failure of the potatoe crop in 1800. Barley is cultivated nearly in the same proportion as wheat, each occupying the land occasionally as the farmer happens to be influenced by the respective price of each. The demand for this grain

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comes chiefly from the breweries and distilleries in the city of Cork, and partly from the breweries in Bandon and Cloghnikilty. There is also to be found here and there a field of bere, or bear, affording a pretty good return. Oats are sufficiently common. About 40 or 50 acres are cropped with hemp. This crop is usually good and lucrative, not so much so, however, as flax, of which considerably more than 1200 tons are annually raised. In the year 1809 there were sown with flax about 1462 acres, out of which it is supposed that 4481 bushels of seed would be saved, besides giving 43,860 stones of flax, at 10s. 6d. per stone. Clover is seldom cultivated by common farmers, excepting on a small scale, and in inconsiderable quantities; indeed it is stated by Mr Newenham, that not more than 5000 acres are sown with this grass throughout the whole island. Potatoes are every where raised by the farmers in abundance, engrossing almost the whole of their manure, as well as of their labour In Doleraine, potatoe land lets as high as six guineas an acre. One preparation for this crop is very commonly paring and burning, especially on the coarser lands, where it is considered as the most expeditious mode of reclaiming waste ground; and it is practised in spite of the legal enactments against it, and the unwillingness of landlords to permit it. In some places turnips are sown, and used as food for sheep as well as cows.

The following Table affords a view of the average quantities of seed used, and of the produce, per English acre, in the southern districts of the county, from which the general state of agriculture there may be ascertained with some accuracy. The average is taken from different years and different estates.

Crops.	Seed used per Eng. Acre. lib. Avoirdupois.	Produce per Eng. Acre. lib. Avoirdupois.	Proportion between seed and produce.
Wheat	161	1,400	1 to 8.9
Bear	140	2,016	1 to 14
Barley	147	1,993	1 to 13.1
Oats	154	1,671	1 to 10.9
Potatoes	952	12,695	1 to 13.1
Flax	16 pecks per Acre.	1,040	1 p. to 65 lb.

Prices of labour, &c.

The average prices of labour, &c. estimated from returns made by persons in different districts, were, in 1811, as follow:—For a man, per day, 11½d.; a woman 6½d.; a carpenter 2s. 11¾d.; a mason 2s. 9¼d.; slater 3s. 5½d.; quarryman 1s. 8¼d.; a thrasher 1s. 5d.; mason, per perch, 1s. 6d.; slater, per square, 6s. 8d.; bricklayer, per perch, 1s. 3d.; blacksmith, per day, 2s. 5¼d.; labour in harvest of hay or corn, per day, 1s. 11¼d.; day labour of children 6½d.; mowing grass, per acre, 4s. 6¾d.; fencing, per perch, 2s. 3¼d.; for grazing a cow, per week, 2s. 4¼d.; for grazing a horse, per week, 2s. 9d.; a car and horse, per day, 3s. 11¾d.; a saddle horse do, 5s. 7¼d.; a plough, do. 9s. 9¾d.; shoeing a horse 3s. 5¼d.; land-carriage to Dublin, per cwt. 8s. 3¼d.; wheat, per barrel, L. 2 : 5 : 6; barley, per do. L. 2, 5s.; oats, L. 1 : 5 : 8; potatoes, per stone, 4½d.; hay, per ton, L. 5 : 3 : 5; beef, per lb. 6d.; mutton 6½d.; veal 6½d.; pork 4d.; lambs, per score, L. 10 : 2 : 6; eggs, per score, 10d.; undressed flax, per cwt. L. 3 : 17 : 6; wool, per stone, L. 1 : 1 : 3.

Manures.

In the bay of Glengariff, and towards the north-west parts of Bantry Bay, there is an inexhaustible store of coral sand, which is held in the highest esteem, and is much employed in the neighbourhood, as a manure. Large quantities of it are dredged up for that purpose. It is purely calcareous; and its effects are said to be perceptible for twenty years. Sea sand, also, containing a great deal of calcareous particles, is very generally used on the coast. It is usually laid upon the ground just as it is brought from the shore; and not unfrequently it is, in the first instance, put into the farm-yards instead of straw, for the cattle to lie upon, and after being impregnated with their urine, and mixed with their dung, is carried out to the fields. It is said to ameliorate very much the quality of the ground, not only by its operation as an alterative, but also in a mechanical way, by opening and mellowing the soil. A great proportion of the manure in this country, as might be expected from its maritime situation, consists of sea-weed, which is annually cut from the rocks, or gathered in the coves and harbours. It is collected with unceasing diligence, and is principally applied to the potatoe grounds. It is a source of considerable profit to the proprietors on the coast. A small strand at Donoughmore lets for £60 per annum, besides supplying the farm within whose bounds it is situated. Marl abounds in this county. It is a favourite manure, used in great quantities, and attended with proportionate effects. Fossil shells also are found here. Dung and straw manure, on which, in every agricultural country, the farmer chiefly depends, is not an object of much attention with the farmers of Cork, and is made by them in very inconsiderable quantities. In some parts, however, it is not uncommon for people to pound their straw into muck on the high road, and for this purpose to have it always spread in front of the farm-house. The roads being made of limestone, a deal of this is scraped off when the pounded straw is removed, and in this way an excellent manure is produced. The farmers, however, have no proper ideas of the importance of manure, and of the necessity of collecting as much of it as possible. As a proof of their ignorance or their carelessness in this respect, we are informed by Mr Townsend, that they often erect their houses upon the very margin of a public road, in the channel of which a great proportion of the manure is washed away; and that, on the same principle—the principle of a most mistaken economy—they grudge a few perches of ground to the use of a farm yard.

Fences.

Fencing is very imperfectly understood in this county, and still more imperfectly practised. Nothing of the tree kind is admitted, which not only gives an appearance of nakedness to the country, but deprives both the corn and the cattle of that shelter which is so conducive to their growth. The usual fence consists of a bank from 4 to 5 feet broad at bottom, tapering to the top, and rising to the height of 5 or 5½ feet. It is formed sometimes of earth dug up from either side, and sometimes it is composed chiefly of stones. This is too often allowed to remain quite bare. But in general it is covered with furze, which, when well grown, makes a tolerably good hedge;—serving the triple purpose of a fence to the field, winter food for the horses, and fuel for the house.

Implements of husbandry, &c.

Most of the usual implements of husbandry are to be found here, but they are unskilfully constructed and unskilfully managed. The plough in common use is extremely rude and defective; as one proof of which it may be stated, that the coulter and sock are placed so obliquely as to oblige the ploughman to turn it to the left side, in such a manner as to keep the mould-board entirely out of the ground. The plough is drawn very

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seldom by oxen, frequently by mules, and generally by horses, the usual team of which consists of three, four, and sometimes more, yoked abreast. Occasionally a plough with two horses is to be seen, which requires one man to hold and another to drive. It is a great sign of rudeness in the agriculture of this county, that no common farmer is provided with a roller or a heavy harrow. This is one reason why their fallows are so imperfectly made. The clods are broken by manual labour: and for this purpose a spade is employed. Indeed the spade culture is in very general use. It compensates in some measure for the sparing use of the plough, and may frequently be used with good effect, where the plough could make little or no impression. The preference of the spade, however, is rather the result of habit than the dictate of judgment. Their flail is very inefficient, made of any kind of wood that can be obtained with least trouble, and seldom heavier than a school-boy's whip. Sliding cars are in common use among the poor farmers, though forbidden by act of parliament to be used on the high roads. But the wheeled-car is now introduced into all the better parts of the county, and is said to answer the purpose extremely well. In the mountainous districts, manure is often carried to the fields in panniers. Almost every gentleman, as well as substantial farmer in the county, has regular labourers, whom he pays with what are called conveniences; these consist in a house, ground for potatoes, grass for sheep and cows, &c. Some of the labourers are paid in money. The potatoes are generally digged and collected by Kerry men, who can earn sometimes by this employment about eight shillings per week, besides their board.

Cattle, sheep, &c.

The breed of cattle in this county is rather of an inferior kind. The farmers, not being able to afford a high price for stock, must be contented to buy it of a small size. In the more hilly grounds, stock of this kind may be considered as most advantageous. Among the mountains towards the south-west of the county, a small breed has been produced, by frequent crossing of the Kerry, or native Irish breed, with the long horned. It has very nearly the same character and properties as the former, which is accounted the best. Lord Bantry has introduced the Devonshire cattle, which are said to answer exceedingly well, both in milk and flesh. There is a great number of dairies in this county, each having at an average about 30 or 40 cows. The favourite breed for milk is the half Holderness breed. The common Irish cow frequently equals them in the quantity, and the Devon cow excels both in the quality, of the milk. The city of Cork is the chief market for the butter produced in these dairies. It has been long celebrated for its sweetness. In the mountainous districts, the male native sheep are to be found. These are of a small size, thin in the fore quarters, narrow in the loins, very active, and covered with nearly as much hair as wool. Gentlemen purchase them for their own use. There are almost no large flocks. Very few are fed on turnips; some on potatoes; and a sheep fold is never to be met with. The Leicester breed has been partially introduced. The sheep belonging to the small farmers are long woolled, and very diminutive in size. Some Merino sheep were disposed of a few years ago at Cork, and bought up for breeding, at high prices. There are considerable numbers of goats, which are kept by all the families that are not able to purchase cows. In some places hogs are kept to a great age, and attain a monstrous size. They are fed and fattened on potatoes only, and are allowed to run about all the while. Throughout the neighbourhood of Bantry, Cork, Cove, and Castlemartyr, they are a long-legged, narrow-backed, ill-shaped breed of animals. Turkeys abound in the county; so much so, that an annual fair is held for them.

Condition of the farmers.

The condition of the farmers is not remarkable either for comfort or respectability. None of the farms are large. Most of them are extremely small. Such as exceed 30 acres are often held in partnership by two or more families. This species of tenure is promoted by their common law of inheritance, which divides the land of the father among his sons. The practice of letting the farm to the highest bidder, contributes also to depress the tenant, as well as to sour his temper. Little or nothing is done to stimulate his exertions and to better his situation, by those who are both able and bound to do it; though to this general statement there are several honourable exceptions in the case of resident proprietors, whose conduct to their tenants is equally just and liberal. The cotter tenant, according to the account given by Mr Wakefield, is in a very miserable plight. He has a cabin and a small patch of potatoe land at a low rent. He also agrees for the keep of a *collop* (10 sheep), or half a *collop*, at a rent still lower. At the same time he works for his landlord at 5d. per day; but when he comes to settle, he receives nothing, as the food of his sheep is set off against his charges for labour. In this way he toils without end, while his family eats up the produce of his spot of ground. The lower Irish call this "working for a dead horse," or getting into debt. All the houses of the farmers and tenants, with a very few exceptions, are wretched. Their mode of living is coarse; their manners are barbarous; and on the whole exhibit nothing on which the patriot's eye can rest with satisfaction.

Rental, estates, &c.

The rental of this county has been variously estimated by different individuals. Mr Townsend takes it at 20s. per Irish acre, Mr Newenham about 30s. and Mr Wakefield takes the medium, viz. 25s. From the large proportion of hilly and unproductive land which the county contains, Mr Townsend's valuation is perhaps the most accurate. At that rate, the whole rental will amount to a little more than a million. According to Mr Young, the average rent of an acre in 1777 was 5s. 2d. making the gross rental of the county at that period about L. 250,000. Mr Wakefield has given in his late work on Ireland the annual revenues of some of the leading proprietors of Cork, which it may be interesting to the reader to state. Lord Bandon has L. 30,000; Lord Shannon, Lord Cork, and the Duke of Devonshire, above L. 20,000 each; the heirs of Smith Barry, and Lord Longueville, L. 20,000 each; Sir John Keane, and Lord Egmont, L. 14,000 each; Mr Freeman, L. 15,000; Lord Ponsonby, Mr Newenham of Coolmore, Mr Anderson, and Lord Riversdale, L. 10,000 each; Mr Jephson L. 12,000; Lord Middleton, Mr Hyde, and Colonel Fitzgerald, L. 8000 each; Lord Arden, and the Marquis of Thomond, L. 6000 each. Lord Carbery has 32 miles of sea-coast, and Lord Kenmore has 20,000 acres.

Rivers.

This county abounds in rivers. The three great rivers are the Lee, the Blackwater, and the Bandon. The Lee rises out of a lake in the west of Muskerry, called Gougane-Barra; after a course of about 26 Irish miles, it divides itself into two branches a little above Cork, and uniting again below the city, falls into the sea ten miles farther down, after affording upon its banks the finest scenery that can be conceived. The Blackwater rises in the mountains between Limerick and Kerry, runs eastward through the county till it en-

Cork. ters Waterford, and after a course of 80 miles, falls into the sea at Youghall Bay. The Bandon rises in the mountains of Carbery, and after a much shorter course than that of the other two rivers, falls into the sea at Kinsale. Besides these, there are innumerable other streams, all of which might be turned to good account were agriculture and manufactures in a prosperous state. Most of them have been immortalized in the poetry of Spenser.

Harbours. The whole coast of Cork, extending to about 37 leagues, is indented with creeks and bays; and affords numerous places of shelter and safety for shipping of the largest burden. Cork, Youghall, Kingsale, Crookhaven, Bearhaven, and Bantry Bay, though the most considerable, are but a few of the multitude of harbours and anchor-grounds with which this coast is furnished.

Fuel, plantations, &c. The fuel in common use is turf, which the poor can buy at a low price; and furze, of which sometimes whole fields are raised for the very purpose. There is also coal in the county, but its quality is not good. English coal is burnt in the sea-port towns, in none of which is it so high by 50 per cent. as it is in London. Some excellent and valuable wood is to be seen in this county. Mr Hyde sold, some time ago, 8000 trees, of 100 years growth, and covering 60 acres, for L. 10,000. There is still, however, a very extensive field for improvement in this respect. There are many thousands of acres which may be planted without much difficulty, and to great advantage. Formerly, there was a considerable quantity of timber, but the trees were cut down and consumed at the iron-works in the 17th century, and no adequate pains have been taken since to supply their place. Planting is now carried on by some individuals with great spirit. There are numerous orchards on the banks of the Blackwater, which are very productive. In various places there are nurseries for the cultivation and sale of forest trees.

Manufactures, &c. There are manufactures of various kinds in this county: of linen, sailcloth, duck, canvas, drilling, &c. In 1808, Sir T. J. Fitzgerald obtained bounty from the Linen Board on 112,782 yards of duck and canvas; and the same year, Mr Julius Besnard obtained bounty for 73,054 yards of sailcloth. Mr Besnard has a rope work at Douglas, two miles east from the city of Cork, with a walk of 232 feet long. At the same place he has two factories which go by water, at which he cards and rows hards, and spins all kinds of linen yarn, but particularly coarse. The young women employed here are not so depraved as in many other factories, because there are scarcely any of the other sex but old men. Within a few miles of Cork, Alderman Lane and Son have a woollen manufactory, where they dress cloth, after it is dyed, by means of machinery which cost about L. 5000, and where they employ altogether nearly a thousand people. In some parts coarse cloth, like Scotch Osnaburghs, is made and exported for negro clothing. The muslin manufacture has been introduced at Bandon. Gunpowder is made in the neighbourhood of Cork: it is the government manufactory of that article, and the only one in the kingdom. There are several breweries and distilleries of large extent; and cider is made from the fruit which grows on the banks of the Blackwater, &c.

Fish and fisheries. All the fresh water fish, salmon, pike, trout, eels, &c. are found here in great abundance, and, on account of the limestone-beds over which many of the rivers flow, are said to be of very superior quality. Herrings and other sea fish, which were once very plentiful on the coast of Cork, have almost wholly disappeared, and there is now no fishery worth mentioning. A good many sand eels, lobsters, craw fish, pearl mussels, &c. are caught; the sun fish, very large and valuable on account of the oil which it yields, is occasionally seen; and seals and porpoises frequent all the havens and headlands in great multitudes.

Minerals. The rocks most prevalent in the county are argillaceous. The greater part of the coast, and of the hills in its vicinity, is composed of a coarse red or grey sandstone, which often varies to a coarser and more slaty fracture; and in this we meet with slate, some of which is fit for roofing houses. Limestone is found in great quantity in almost every district, and at a cheap rate. A large seam of it commences in the peninsula of Cork bay, and the islands in Cork harbour, and extends on the south of the river Lee to a considerable distance. It contains a variety of fossil shells; and some of it, when scraped, has the unpleasant smell of stinkstone. In the limestone quarries near Cork, transparent quartz and large amethysts are found. The Galtee mountains are composed of a very coarse pudding stone, in which there is a great deal of iron shot quartz. Several quarries of marble, admitting of a good polish, and extremely beautiful, have been opened in the neighbourhood of Cork. This county is not destitute of coal. It is wrought on the barony of Duhallow, but is of a sulphureous stone quality, and not very good for domestic and culinary purposes. Charcoal is usually employed for kindling it. A bed or two, however, of superior purity, have been discovered, and are now the object of attention. There is abundance of iron-stone and some copper ore in the county; and both of them were formerly wrought with no small success, but the works have been long since discontinued. Ochre is widely diffused, and of a great variety of colours. A saponaceous earth, like fullers' earth, is found in abundance near the old head of Kinsale. About a mile west from Cloyne there is a stratum of clay, six feet thick, remarkable for being as white as snow, and made use of for whitewashing the walls of houses, taking grease out of boards, and composing glaziers' putty.

Weights and measures. The weights and measures used in this county, are, with a few exceptions, the same that are used throughout the kingdom. The cwt. weighs 8 stone, or 112 lb. The barrel of barley is equal to 3 kilderkins, and each kilderkin is 12 stone. The barrel of oats is equal to 3 kilderkins, and each of these kilderkins is only 11 stone. The English acre is used through all the southern parts of the county. Potatoes, when retailed in market, are sold by a measure called a weight, generally containing 21 lb.

Political divisions, &c. Cork is divided into 16 baronies, and 269 parishes. It returns eight members to the imperial parliament; of these there are two for the county, two for the city of Cork, and one for each of the burghs of Kinsale, Youghal, Bandon-Bridge, and Mallow: The voters for the county members are 20,000. It furnishes three regiments of militia; one for the city, another for the north district, and a third for the south district, of the county.

Ecclesiastical divisions, &c. The county of Cork contains the bishoprick of Cloyne, founded A. D. 600, and that of Cork and Ross, united A. D 1586. That of Cloyne contains 137 parishes; and that of Cork and Ross contains 127. The number of beneficed clergymen in the former is 56, and their collective revenue upwards of L. 40,000. The collective revenue in the latter amounts to L. 30,000. The income of the Bishop of Cloyne, according to Mr Young,

Cork.

in 1779, was L.2500, and according to Mr Wakefield it is now L.5000. That of the bishop of Cork and Ross, according to Mr Young, was L.2700, and according to Mr Wakefield it is now L.4500. These dioceses are under the Archbishop of Cashel.

Antiquities.

The principal antiquities of this county are the following: Subterraneous caves near the cathedral church of Roscarbery, of the origin and use of which there is no probable account: Round towers (of which there are so many in Ireland) one at Cloyne, one at Kineth, and the stump of one at Ballybeg; a very large tomb composed of enormous stones, situated about a mile east from Glanworth on the road to Fermoy; and circular monuments of stone, of which there are several remaining, in the mountainous districts.

Medicinal springs.

Dr Smith, in his natural and civil history of Cork, mentions and describes no fewer than 23 medicinal springs, mostly chalybeate, some of which have been found useful in scorbutic and scrophulous disorders. He also notices at length the warm springs at Mallow, on the south side of the town, but on the north side of the Blackwater river. They are frequented by invalids, who often derive benefit from the use of the waters.

Extent, population, &c.

The greatest length of this county is about 100 miles, and its greatest breadth above 70. It contains about 2653 square miles, or 1,697,820 acres. The number of houses, according to the parliamentary return in 1791, was 76,739, of which 56,422 paid for one hearth, 2344 were exempted as new, and 8949 as paupers, and the rest paid for more than one hearth. The number of inhabitants is computed to be 416,000. This gives 5.42 inhabitants to each house; 4.05 acres to each inhabitant, or 21.951 acres to each house; and 156.8 souls to a square mile. Mr Newenham makes the population of the county and city to be so great as 675,364, which gives 8.8 souls to each house. Of this population a vast proportion belongs to the Roman Catholic church. From a return made by the collector of hearth money, in 1732 and 1733, it appears that the Catholics were to the Protestants at that period, in the city, as more than 2 to 1, and in the county as 8 to 1. In 1740, the supervisors of hearth-money, in their return, made the number of Protestant families to be 4053. By the returns made in obedience to the order of the House of Peers, in 1766, it appears that, in the diocese of Cork and Ross, there were 4814 Protestant families, 23,039 Catholic families, 25,471 Protestants, and 108,634 Catholics. In the diocese of Cloyne, there were 1534 Protestant families, and 12,971 Catholic families. The number of individuals was not returned; but making the number of individuals in a family the same in that diocese as in the other, the number of Protestants would be 8130, and the number of Catholics 60,963. At present, according to Mr Newenham, in the city of Cork, and the towns of Youghal, Bandon, Kinsale, and Cloghnikilty taken together, the proportion of the Catholics to the Protestants is more than 6 to 1; and in the other towns of the county not less than 12 to 1. In the three regiments of militia, the proportion among the privates (for their officers are almost all Protestant,) is upwards of 7 to 2. See Beaufort's *Memoir of a Map of Ireland*; Smith's *Natural and Civil History of Cork*; Hall's *Tour through Ireland*, vol. i.; Wakefield's *Statistical and Political Account of Ireland*; and Townsend's *Survey of Cork*. (τ)

CORK CITY, the capital of the county of Cork, and the second town in Ireland. It is situated on the river Lee, which is here of considerable size, and contributes equally to its local beauty and commercial advantage. On all hands it is surrounded by high ground. It stands partly upon an island formed by the Lee, as Spenser describes it in these lines,

> "The spreading Lee, that, like an island fair,
> Encloseth Cork with his divided flood;"

but it lies chiefly on the south bank of the river. From its being placed in a hollow, and having few spires, it has a dull appearance when seen from a distance. It is said to be unhealthy, there being but an inconsiderable number of the inhabitants who live till eighty, and the military who are quartered there suffering soon and much from disease. There are several bridges over the Lee. Of these the handsomest is St Patrick's, over the north channel. It is considered as one of the finest structures of the kind in Europe. Some of the streets are extremely dirty—a few of them, such as the Parade, Newbridge Street, &c. are straight and clean, elegant, and even showy. The old custom-house is an extensive building, and on the eve of being superseded by a new and more suitable one. The public markets, which are situated almost in the centre of the town, are very neat and convenient. The court-house and exchange are tolerably commodious. The new barracks cost government £80,000, and are capable of containing 4000 infantry, and 1000 horse: the old barrack is retained; and there is besides a barrack for the artillery. There are many handsome houses, both in the city and its neighbourhood, belonging to opulent individuals. Cork contains a cathedral and seven or eight churches belonging to the establishment, besides a great number of chapels and meeting-houses for the Dissenters and Roman Catholics. Upper Shannon church stands on an eminence, and has a tall spire, which is seen at a distance. There are two theatres, and about 500 ale-houses and taverns. There are here plenty of schools, Protestant and Catholic, which are well attended, though not always judiciously taught. There is also a public library, well stored with books, supported by 200 subscribers, at the rate of 1½ guineas entry money, and 1 guinea per annum. An "Institution for applying Science to the common Purposes of Life," has been established, and is in a flourishing state. It originated in private subscriptions. It has a good collection of minerals, a scientific library, and apparatus necessary for illustrating lectures in natural philosophy. Government have given it L.2000, and ground is already procured for a Botanical Garden. There are two Foundling Hospitals, one for the Protestants, founded in 1747, containing generally about 300 children, and supported by a tax on coal; and another established lately by the Roman Catholics for their own communion:—a school of industry, where 50 boys and as many girls are taught the ordinary branches of education and industry—an infirmary—a hospital—a workhouse—a house of recovery, intended chiefly to prevent the spread of contagious diseases—a charitable repository, to which ladies send needle-work to be disposed of for the benefit of the poor—a house of industry, containing an infirmary, house of correction and madhouse, having 200 people in all, and costing annually from L.4000 to L.5000—and many other benevolent institutions.

The bay and harbour of Cork are situated about seven or eight miles farther down the river. In the harbour there is an island of considerable extent, called Great Island, containing the town and quay of Cove. Vessels of 120 tons can go up to the city quays; but the large ships lie at *Passage* a few miles lower down.

The harbour is capable of containing an immense number of ships in perfect security, and is now a place of rendezvous for fleets destined to the West Indies. Its mouth is defended by Carlisle fort. The fortifications on Spike Island are said to have cost a million sterling.

Manufactures of various kinds are carried on—linen, checks, carpets, glue, gunpowder, glass, &c. There are four distilleries, besides five or six rectifiers of spirits, who work under special licence from the commissioners of excise. The greatest distillery, carried on by Mr Walker, makes 17,000 gallons per week, and works from 9 to 10 months in the year. The other, belonging to Messrs Hewson and Co. produces 9000 gallons per week. The former is said to pay L. 200,000 per annum of duty to government. Besides many breweries for ale and small beer, there are five for porter. The principal one belongs to Beamish and Crawford, who brew 2000 barrels of 46 gallons each per week, which they sell at 10 d. per gallon.

The principal exports of Cork are salted provisions, beef, pork, and butter, which are collected there, for being shipped, from all the southern parts of Ireland. At an average 10,000 oxen and 8000 cows are slaughtered annually. In 1807, about 3600 head of cattle were killed and 50,000 hogs; but it appears the slaughtering of the former is on the decline, and that of the latter on the increase. Dr Smith says, that the number of cattle slaughtered from August to Christmas, in each year, was little less than 100,000. In 1791, upwards of 50,000 barrels of beef, and about 7000 tons of butter, were exported. In 1806, the quantity of butter was 160,000 cwt. One half of the hides procured at Cork are exported; the other half, consisting of the heavy ones, are retained at home for shoe leather. All the linens and woollens from the south of Ireland, intended for a foreign market, are shipped here. Corn, also, porter, tallow, and cattle-hoofs, are exported. From a report made to the House of Commons, it appears, that in 1791 there was exported 49,080 barrels of corn—23,374 cwt. of flour, meal, and bread—55,525 barrels of beef—38,948 barrels of pork—13 live hogs—139,507 cwt. of butter—and 1,197,729 yards of linen cloth. In 1802, 185,059 gallons of Irish spirits were exported from Cork; in 1803, the quantity was 492,665 gallons; in 1804, it was 340,965 gallons; in 1805, it was 311,241; and in 1806, it was 199,027. The imports of Cork are chiefly those ordinary articles of consumption, such as groceries, coal, &c. which are not otherwise found in the resources of the city and county.

Prices of Ox and Cow Hides, Rough Tallow, and Grain, at Cork, furnished to Mr Thomas Newenham by Mr Hacket, Farmer, Mr Hawkes, Tallow-chandler, and Mr Good, Corn Merchant, 30th October 1811.

	1801.	1802.	1803.	1804.	1805.	1806.	1807.	1808.	1809.	1810.	1811.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Ox hides per cwt.	53 0	53 0	53 0	53 0	53 0	53 0	41 0	55 0	56 0	46 0	
Cow hides do.	42 0	56 0	54 0	56 0	50 0	46 0	34 0	32 0	34 0	36 0	
Rough tallow per stone, of 16 lb.	9 6	9 6	9 6	9 6	9 6	9 6	9 6	13 0	12 0	9 3	8 0
Wheat per barrel of 20 stone	36 0	40 0	36 0	36 0	34 0	34 0	38 0	36 0	38 0	37 0	44 0
Barley do. 36 stone	42 0	42 0	41 0	40 0	38 0	39 0	42 0	44 0	44 0	44 0	40 0
Oats do. 33 stone	26 0	29 0	28 0	28 0	27 0	27 0	27 0	36 0	36 0	35 0	34 0

In November 1808 there were five bankers in Cork. One of them has since failed for L.420,000. There was also a discount office. In 1804, the private notes in circulation from the Cork banks were thought by Mr Roach to be L. 1,000,000. Mr Beresford estimated them at L. 600,000.

At each entrance to the town there is a gate; but no police has yet been established for preserving its order, and attending to its economy. The corporation consists of a mayor, two sheriffs, a recorder, and several aldermen. The mayor is chosen by a kind of lottery. No one is styled alderman till he has been mayor. The mayor, while in office, has a salary of L. 500 per annum. Cork is the seat of a bishop. It sends two members to the imperial parliament. The electors are composed of about 1500 freemen of the city, and a number of freeholders in the county of the city, which is pretty extensive. The population of this city has been variously estimated. In the year 1732, according to a return of the collectors of hearth money given by Dr Smith, it amounted to 55,769, of whom 17,983 were Protestants, and 37,786 Catholics; there being 2569 families of the former, and 5398 families of the latter. According to Dr Beaufort, the number of inhabitants, in 1791, was nearly 73,000, distributed among 8100 houses, which gives about 9 to a house. Mr Newenham says, that, according to an accurate enumeration made at his request by the Roman Catholic clergy, within the four years preceding 1811, there are in the city, *exclusive of the liberties, which are very populous*, 6416 inhabited houses, and 55,265 inhabitants, of whom 45,205 are Roman Catholics, and 10,060 Protestants; making in the whole an increase to the population since Dr Smith's estimate, of all that may be supposed to inhabit the liberties. Mr Wakefield thinks that there may be about 80,000; while others make the number several thousands more. Cork is situated in 51° 53′ 54″ North Lat. and 8° 30′ West Long. It is 161 miles south-west from Dublin. See *the works referred to at the end of last article.* (τ)

CORN, in agriculture, is said properly to mean "grain in the ear," or "grain unthrashed," but is generally taken in the much more comprehensive sense, of grain fit for food in whatever stage of preparation. Wheat, rye, barley, oats, &c. and, according to the current language of many farmers, even pulse, as pease and beans, come under this denomination. Under the head of AGRICULTURE, we have treated so fully of the various modes of raising corn, that the only subject which at present remains to be considered is our system of corn laws.

CORN LAWS form altogether a large body of enactments in our statute books, as they embrace the home as well as the foreign trade in grain. Few departments of our code have excited more serious difference of opinion; the political economists contending, that the corn trade should be left wholly free and unfettered, while the agriculturists insist, that it is indispensible for the good of husbandry, to prevent, by means of public regulations, the fall of grain below a specified rate. The opinion of government has varied, as we may naturally imagine, in different ages, according to the preponderating interest, or according to the different degrees of information possessed at the time. On one occasion we find it a prevalent opinion, that corn was too good a commodity to sell to our neighbours; on another, that the more we sold the better, because by that means additional sums of money were brought into the kingdom. The former was, and will continue to be, the natural feeling of the consumers, that is, of the people at large; while the latter may be regularly expected to influence the landholder and farmer. The crown, or executive power, looked by preference at revenue, and cared, in former ages, very little whether we sent our corn abroad, or imported that of foreign nations, provided the one or the other could be rendered instrumental in filling the coffers of the treasury. However, for the last century, all idea of raising revenue from corn has been relinquished, and the executive power has been actuated by other considerations, viz. the desire of uniting the landed interest in support of a war, by passing acts to raise the price of corn when it was low; and, on the other hand, a wish to prevent popular discontent, by favouring the import of foreign corn, when our own markets had reached an exorbitant height.

The subject of corn laws naturally divides itself into two parts; a narrative of our past proceedings, and a disquisition on the principles which ought to regulate this branch of trade. We begin with the former.

I. *Historical sketch of our Corn Laws.* The first law relative to the exportation of corn occurs in the year 1360, and contains a prohibition of sending our corn abroad. In the succeeding reign, in 1394, a counter-edict was passed, and all the king's subjects were authorised to export corn on payment of the ordinary duties. In that rude age, government were far from ascribing to the encouragement of export any ultimate effect in cheapening prices at home. Notwithstanding the temptation of revenue, the prevalent bias was to keep our corn at home, in conformity to which the law long continued to permit the import of foreign corn. In 1436, the export of English corn was put under more definite limitations, being declared legal only so long as our own currency should be at a moderate rate, corresponding to 35s. per quarter for wheat at the present day, and 16s. for barley. Such continued to be the law of the land for nearly a century; and the leading motive was evidently a desire to keep our provisions at home whenever prices were high, a result which might have been very safely trusted to the natural course of things. In the year 1552, however, a farther and a very decided step was taken for the discouragement of the export of corn, an act being passed to prohibit it so long as wheat should be above a price equivalent only to 17s. of our present money the quarter, or barley above the equally low price of 8s. 6d.

In regard to the import of foreign corn, the first discouragement of importance consisted in an act passed in 1463, which contained an absolute prohibition of introducing it into the kingdom, unless our own prices exceeded 35s. (present money) for wheat, and 16s. for barley. Our corn growers however complained, that the act was of little efficacy, partly from remissness at our custom-houses, and partly from the rapid diminution in the quantity of silver coined in the shilling, the effect of which, in the course of time, was to make the nominal sum above-mentioned equal only to half its value. Of course, as the quarter of wheat could very seldom fall below 16s. or 17s. the practical consequence was an almost perpetual liberty to import. But in the reign of Elizabeth, new regulations were framed, and allowance was made for the altered value of the currency After re-enacting the old laws, which enjoined, in positive terms, the tillage of the land, and rebuilding of farm-houses, her ministers, proceeding on the comparatively new principle, that it was politic to encourage export, procured an act of parliament for permitting it so long as corn should not exceed a rate which, in wheat, was equal to 28s. a quarter of our present money, and in barley to 16s. 7d. The price of 28s. although inferior to the rate which we have just mentioned, as enacted in the preceding century, was greatly superior to the actual value to which that rate had by this time fallen, by the reduction of the quantity of silver contained in the shilling.

This first modification of our corn laws in the reign of Elizabeth, took place in 1562. In 1570, there was passed an act, apparently of much greater latitude, permitting the export of corn without limitation of prices, whenever there should be no existing prohibition; but the accompanying imposition of a duty of 10 *per cent. ad valorem* on the export, operated as a deduction from the efficacy of this ostensibly important privilege. The provisions of the act deserve attention in two respects; first, as indicating a continued belief of the policy of raising a tax from corn exports; and, secondly, as proving the remarkable diversity of price in different districts. In the present age of extended communication, and multiplied means of carriage, we can with difficulty form an idea of the effect of the impediments at that time on the exchange of commodities between one district and another. A journey of a hundred miles was in those days the labour of a week, and performed with considerable hazard through sloughs, across mountains, and over rivers without bridges. The miserable method of carrying corn and other commodities in sacks on horseback, was consequently much more common than the apparently obvious plan of cart or waggon carriage. We must, therefore, be cautious how we draw conclusions in regard to the general price of wheat from the local reports of former times. Besides, wheat being then the food of the richer classes only, was not, as at present, an index of the relative prices of the ordinary diet of the lower orders.

Another cause of fluctuation in those days, was the rigour of the law against the supposed offences of forestalling, regrating, and engrossing. Though the popular mind has, for many ages, been stimulated in favour of these laws, by the plea that they conduce to keep down the markets, the original motive for their enactment was of a very different description. A duty, or toll, was levied in the different markets and fairs of the kingdom, and was paid partly to the royal treasury, partly to the baron who possessed the landed property of the surrounding district. It became an object with purchasers, as well as sellers, to attempt the evasion of these duties, and to endeavour to make their bargains on the road, or in places distinct from the public markets; hence the laws enacting a compulsory attendance at these markets,—laws of much the same character, in respect to equity or policy, as the statutes passed to maintain tillage, and restrict pasturage, by dint of penalties. The exportation of wool to the continent, particularly to the manufacturing country of Flanders, had, in the fourteenth and fifteenth centuries, become considerable, and had rendered government apprehensive, that the frequent conversion of corn-land into sheep walks might injure the prosperity of the kingdom. Accordingly acts for the increase of tillage were successively passed in 1488, 1515, 1534, 1552, and 1562.

Towards the end of Elizabeth's reign, the prices of corn rose to a high rate, wheat being in 1596 and 1597 at the price of £4 a quarter. The importation of corn continuing unrestricted, we are to account for the duration of this rise in price by a succession of indifferent harvests at home, and by the very limited means of that age, either of importing from abroad, or of distributing foreign corn into the interior when it had actually reached our harbours. The former low prices being in a manner obsolete, the law relative to exportation underwent a change, and liberty was given to send grain out of the kingdom, though prices should be beyond the former limit. But as a duty of 2s. a quarter on wheat, and 1s. 4d. on other grain, was still collected, the permission of export was in some degree counteracted. During the pacific reign of James I. two acts took place in regard to the corn trade. Both enforced the above-mentioned duties, and both made a partial extension of the limits at which exportation became lawful. By the last act, passed in 1623, wheat was exportable so soon as our home currency fell to 32s. a quarter, and barley at 16s. As these were, not unfrequently, the actual rates in particular districts, it is probable that various exports took place, and that a considerable revenue was collected from this source.

During the unsettled period which followed the accession of Charles I. we meet with no alterations in the existing system of corn laws. The Restoration, however, gave rise to fresh enactments, founded partly on a consideration of the wishes of the landed interest, partly on a scheme of revenue. Exportation was permitted at any time when wheat at home should not exceed the price of 40s. and barley 20s. The laws relative to importation were also new modelled; foreign corn being, in a manner, excluded so long as our own market was at a reasonable rate (44s. for wheat); and being burdened with a duty of 6s. 8d. a quarter, even when our own prices were high. In addition to the object of revenue, the view of government in these laws was perhaps to proportion, as nearly as possible, the national growth of corn to the national consumption. However, prices in the succeeding years rising very high, importation was allowed by an act in 1663, without reference to the state of home markets, at the comparatively moderate tax of 5s. 4d. on a quarter of wheat, and 2s. 8d. for barley. Such was the law in England during seven years. In 1670 there was passed a fresh act, which seems to discover a marked attention to the views of the landed interest. By this act, foreign corn was loaded with a high duty so long as our own could be afforded at a reasonable rate (53s. 4d. for wheat); while exportation was declared lawful without reference to the state of markets, but always with the obligation of paying an export duty. The actual state of the corn trade during the chief part of the reign of Charles II. is said to have been a suspension of export, and a partial admission of import, our market prices being generally so high as to admit foreign corn at the duties prescribed by the act of 1663.

We have now arrived at the æra of 1688, an æra as important in the history of our corn laws as of our liberty, however different the merits of the measures respectively adopted. The Revolution was the epoch of the reinstatement of the authority of parliament; and it is here the place to remark, that the laws which profess to favour the landed interest at the expence of the nation at large, proceed not from the crown, which has no interest in such enactments, and still less from the people who are the sufferers, but from the members of our legislature, in other words the great proprietors of land. This is easily shewn by a retrospect to the proceedings of government. During the suspension of parliaments under Charles I. and during the virtual abolition of their authority under Cromwell, no measures were taken in favour of landholders. But in 1688, no time was lost in encouraging the export of corn by the new expedient of a bounty. An act was passed declaring, that whenever wheat in the home market should be at or below 48s. and barley at or below 24s. there should be allowed a bounty, or export, of 5s. a quarter for wheat, and 2s. 6d. for barley. Mr Dirom and other advocates of the bounty system, are so enamoured of this law, as to be unable to refrain from expressing their surprise that it should not much sooner have engaged the attention of our ancestors. The grand argument brought forward in its favour, is its tendency to prevent the occurrence of scarcity, by inducing the farmers to raise a surplus stock of corn. The real view, however, regarded an object more directly resulting from it, namely, the raising of the rent of land, farmers being induced to come under contract for a larger rent, when assured, by the first authority in the country, of the permanency of a high currency for their produce. By a subsequent act in 1700, every thing in the shape of duty on English corn, ground or unground, was relinquished by the crown; and in 1707, on the union with Scotland, the operation of the corn laws was rendered similar throughout Great Britain.

The acquiescence of the crown in the remarkable innovation produced by the act of 1688, is to be chiefly ascribed to King William's solicitude to unite the leading men in the country in his great contest against Louis XIV. A similar motive actuated government during the reign of Queen Anne; and before the conclusion of our long struggle with France, the bounty system had become consolidated with the laws of the land. It was accompanied by restrictions on the import of foreign corn, of so heavy a nature as almost to amount to a prohibition. The result of the bounty was, as may naturally be conceived, a large exportation in years of favourable crop. After the peace of Aix la Chapelle, for example, the average exportation for four years was above 1,200,000 quarters each year; while the price of wheat for the same time was only 36s. 3d. a quarter. It is a curious fact, that the bounty system had not, on taking a comprehensive view of its operation, the effect of creating a general or permanent rise of prices. On comparing the seventy years which followed the enactment of the bounty with the seventy that preceded it, we shall find (*Wealth of Nations*, vol. i. p. 418) that the price of wheat was considerably lower in the latter period. There seems little doubt that the bounty, by carrying cultivation at first too far, counteracted the object of its short-sighted projectors; and rendered our growth of corn disproportioned to our consumption. Whatever may have been the cause, the fact was, that prices did not assume the character of a progressive rise till after 1760. By that time the increase of our population employed in navigation, manufacture, and trade, began to be such as nearly to equal by their consumption the produce of the agriculturists. It is to this cause, and by no means to the imagined effect of corn laws, that we are to attribute the flourishing state of the landed interest in our own time. So long as the bounty system was unaided by any thing like a considerable advance in the general prosperity, that is, duing the first sixty years of last century, "no rise of rent was ever thought of, and lease after lease, in long succession, were signed without a word passing upon the question of rent; that was an object considered as fixed, and grandfather, father, and son, succeeded without a thought of any rise; in many cases landlords were much more apprehensive of losing a tenant at the old rent than having the smallest conception of raising it to a new one." *

The rapid rise in the price of corn during several years preceding 1773 induced government to resort at first to temporary prohibitions of export, and to a disuse of the mistaken enactments of former ages against the intervention of middle men in the corn trade. In 1773, there was taken the decisive step of abrogating the bounty on the export of corn, until our markets should fall below the price at which it was formerly allowed, viz. until wheat should be at the current rate of 44s. a quarter, and barley at 22s. This was little else than withdrawing the bounty *in toto;* but what was of more direct influence on our corn-market, was the abolition of the restraints on the importation of foreign grain, the same being admitted at a very trifling duty, so long as the currency of our markets should be at or above 48s. for wheat, and 24s. for barley. This revolution in our corn-laws has been ascribed to the enlightened influence of Dr Smith and Mr Burke, but arose more immediately from a consideration of the popular discontent attendant on the rapid advance of prices. The object of government, an object which has, more or less, actuated our subsequent corn statutes, was to maintain, as far as the uncertainty of seasons would allow, a kind of level in the currency of our corn market. The advocates of the bounty system were loud in declaiming against this decided change in our policy, and have ascribed to it that reduction and almost total cessation of our corn exports, which may be much more justly and satisfactorily attributed to the increased consumption attendant on an augmented population at home. They are by no means disposed to subscribe to the fundamental assumption of the act, viz. that the price of 48s. was fair both for grower and consumer, or to the policy of calling in a foreign supply whenever our markets should exceed that rate. Government, however, have adhered stedfastly to the principle of endeavouring to keep corn as near a level as possible, and have been actuated by it on the two occasions (in 1791 and 1804) on which our corn laws have undergone a modification. The former of these was little else than a slight alteration in the specified rates of 1773, in consequence of the fall in the value of money.

In 1804, by a farther extension of the specified rates, the importation of foreign corn was, in a manner, prohibited so long as our own was sold at 63s. and it was burdened with a duty until our own should reach 66s.

Abstract of the Corn Bill of 1804, as far as regards Wheat.

When our own wheat sells at home at or below the average of . . . . 48s.
there is a bounty of 5s. a quarter on export.

On our average rising to . . . . 54s.
our wheat is no longer exportable.

When our average rises above . . . . 63s.
foreign wheat is importable at a duty of 2s. 6d.

And when our average rises to . . . . 66s.
foreign wheat pays only a duty of 6d. a quarter.

With the view of giving a preference to the produce of Canada, the act directs that the wheat of British colonies shall be admissible at a duty of 2s. 6d. whenever our home average exceeds . . . . 53s.

And at the low duty of 6d. whenever it exceeds 56s.

The fall of price consequent on peace, and on the favourable harvests of 1802 and 1803, had alarmed the landed interest, and induced them to extort from government the above act, which was productive of much popular discontent, and which the result has shewn to have been wholly unnecessary. The landholders were apprehensive of being unable to keep up their rents, and ministers eager, like King William, for the cordial support of the men of property in the war with France, assented to that which they were hopeful would produce only a temporary dissatisfaction. But as all parties were agreed that the contest with France was likely to be of long duration, and attended with burdens which would materially depreciate money, or, in other words, raise the price of corn, the matter might have been safely left to the unaided operation of these causes. The fact is, that since 1804, our average prices of wheat have been *constantly above* 66s. and the provisions of the act have been consequently unnecessary. They may be applicable, however, in the event of peace, and of a large free importation from abroad.

Having finished the narrative of our corn laws, we proceed to adduce a few tables calculated to shew the progressive changes in this branch of trade. Dr Anderson has exhibited the following Table of the

Average prices of wheat in England from the year 1650 to 1700.

		s.	d.
For 10 years preceding	1650	59	5
10	1660	58	8
10	1680	54	0
10	1690	46	11
Average of 40 years		59	9
1700, by itself, was so high as		68	3

No account of exports or imports was kept until 1697. At that time the effects of the bounty system in leading to exportation began to be apparent.

Exported more than imported in wheat and other grain of all kinds.

			Average price of wheat. s.	d.
4 years preceding	1700 on an average	80,000 qrs.	58	1
10	1710	284,000	51	10
10	1720	449,000	37	0
10	1730	375,000	36	6
10	1740	541,000	37	6
10	1750	833,000	23	8
Average price of 50 years			36	2

		s.	d.
The year of our greatest exportation was 1750, the quantity sent abroad being no less than	1,667,000	32	6

* Young on the Progressive Value of Money, p. 102.

			s.	d.
10 years preceding	1760 on an average	545,000	42	6
5	1765	573,000	42	2

During these 15 years, the great rise in the price of corn began to produce a very different feeling in regard to the policy of our bounty system. It was, in fact, the interval during which our consumption was coming round, first to an equality with, and eventually to an excess over, our importation. Increase of population now led to a reverse of the picture, and we are henceforth to state the

Excess of Imports over Exports.

		Price of Wheat. s.	d.
5 years before 1770	247,000 qrs.	53	1
5 1775	505,000	49	10
5 1780	27,000	38	7
5 1785	267,000	47	2
5 1790	412,000	45	6
5 1795	1,184,000	52	6
5 1800	2,138,000	66	6
Average of 50 years		49	5

The year 1800 was the one of greatest importation, the excess of export over import being no less than 2,939,000 qrs. and the average price of that year being so high as 110*s.*

It is thus apparent that our dependence on foreign countries for a supply of corn has arrived at a very serious extent. The experience of the last ten years is in correspondence with the conclusions to be drawn from the latter part of the above table; and even with the benefit to be derived from the labour of additional hands in time of peace, we shall not be safe in estimating the annual imports required in corn of all sorts at less than 1,500,000 qrs.

In the Baltic, Dantzic being the great port for exportation, the prices there afford a criterion for the currency of the other markets along the coast, while they are themselves regulated by the state of the English markets.

Export of wheat from Dantzic, from the year 1793 *to* 1803, *inclusive; stated in* lasts, *and taken from the annual accounts published in that city. The* last *being a measure of* $10\frac{1}{4}$ *quarters.*

Years.	To England. *Lasts.*	Other parts. *Lasts.*	Total. *Lasts.*
1793	9,451	5,963	15,414
1794	6,244	12,529	18,773
1795	4,283	9,491	13,774
1796	20,407	6,474	26,881
1797	17,496	6,398	23,894
1798	18,357	7,991	26,348
1799	16,713	8,311	25,024
1800	37,202	3,661	40,863
1801	33,748	3,855	37,603
1802	27,028	25,388	52,416
1803	11,725	22,424	34,149

Ireland has, particularly of late years, become one of our great sources of supply. After much jealousy on the part of British landholders, and repeated restrictions on the admission of Irish corn into Great Britain, government was at last, in 1806, enabled to pass an act "permitting the free interchange of every species of corn between Great Britain and Ireland." An end was thus put to the impolitic list of duties on grain, meal, flour, bread, &c. imported from the sister island, and a trade, considerable at that time in spite of custom-house difficulties, has recently become one of the greatest importance to both countries. The following short table conveys an idea of its extent prior to the operation of the act of 1806.

A Return of the Quantity of Grain and Flour exported from Ireland from 1802 *to* 1807 *inclusive.*

Years.	Wheat.	Oats.	Other Grain.	Wheat, Flour, and Oatmeal.
	Barrels.	Barrels.	Barrels.	Cwt.
1802	168,937	475,066	16,180	199,810
1803	101,901	391,102	37,402	119,762
1804	152,828	372,690	24,652	88,826
1805	134,871	346,244	38,917	57,071
1806	153,214	461,700	26,640	79,665
1807	68,003	724,347	76,010	56,661

Since 1807 the agriculture of Ireland has been greatly extended, and her exports of corn have been much larger. Oats form the principal article; and in 1809 the importation of them into England was nearly 800,000 quarters. The progressive advance in the price of wheat is indicated by the following

Return of the annual average Prices of Wheat in Ireland from 1784 *to* 1809 *inclusive.*

Years.	Per barrel of 20 stone.	Years.	Per barrel of 20 stone.
1784	£1 8 0	1797	£1 6 $8\frac{1}{4}$
1785	1 3 $3\frac{3}{4}$	1798	1 7 $4\frac{3}{4}$
1786	1 3 8	1799	1 12 $4\frac{1}{4}$
1787	1 3 $2\frac{1}{4}$	1800	2 16 $4\frac{1}{2}$
1788	1 2 4	1801	2 16 7
1789	1 6 11	1802	1 11 $6\frac{3}{4}$
1790	1 8 $2\frac{1}{4}$	1803	1 9 $0\frac{1}{2}$
1791	1 6 $1\frac{1}{2}$	1804	1 9 10
1792	1 3 $4\frac{1}{2}$	1805	1 16 $7\frac{1}{2}$
1793	1 5 $9\frac{1}{2}$	1806	1 19 6
1794	1 10 $10\frac{3}{4}$	1807	2 0 1
1795	1 14 $10\frac{1}{4}$	1808	2 4 $9\frac{1}{2}$
1796	1 18 5	1809	2 7 $3\frac{3}{4}$

The west coast of Scotland is, in general, very unproductive of corn, so that a brisk trade of import, particularly in oats, is carried on with the sister island. In 1809, the quantity of oats imported from Ireland to Scotland amounted to 402,000 quarters.

The average price of wheat in Scotland is considerably lower than in England, a difference to be attributed partly to the greater distance from the metropolis, the great scene of consumption, and partly to inferiority of quality.

Return of the annual average Price of Wheat in Scotland from 1771 *to* 1809 *inclusive.*

Years.	Wheat, per quarter.	Years.	Wheat, per quarter.
1771	39*s.* 6*d.*	1774	42*s.* 2*d.*
1772	41 6	1775	37 2
1773	42 8	1776	31 0

Years.	Wheat, per quarter.	Years.	Wheat, per quarter.
1777	34*s.* 4*d.*	1797	44*s.* 3*d.*
1778	33 10	1798	41 9
1779	27 0	1799	57 1
1780	29 8	1800	89 4
1781	36 6	1801	100 9
1782	35 2	1802	63 7
1783	42 2	1803	49 9
1784	40 0	1804	53 5
1785 to 1791	no return	1805	76 4
1792	38 2	1806	66 5
1793	42 9	1807	66 7
1794	46 4	1808	71 8
1795	66 3	1809	85 6
1796	70 8		

An Account of the quantity of Wheat and Wheat-Flour imported into England from the United States of America and other Foreign Countries, from the 5th January 1804 *to the 5th January* 1810.

Years.	Wheat. From the United States of America.		Wheat. From other foreign countries.		Wheat-Flour. From the United States of America.			Wheat-Flour. From other foreign countries.		
	qrs.	b.	qrs.	b.	cwt.	qr.	lb.	cwt.	qr.	lb.
1804			324,639	5	14,478	1	16	41	3	0
1805			780,778	1	46,966	1	19	5,581	0	27
1806	8,987	0	95,055	5	240,227	2	18	15	0	4
1807	102,328	3	65,100	1	466,715	2	2	2,175	2	18
1808	8,924	5	7,295	5	13,685	2	13	315	0	20
1809	34,569	7	187,900	3	439,830	0	2	411,024	2	19

In peace, it is likely that our imports from America will much exceed the limited quantity received in the above mentioned years.

We are next to exhibit a computation of the proportion of land cultivated for different purposes in England and Wales.

	Acres.
Wheat	3,160,000
Barley and rye	861,000
Oats and beans	2,872,000
Clover, ryegrass, &c.	1,149,000
Roots and cabbage, cultivated by the plough	1,150,000
Fallow	2,297,000
Hop grounds	36,000
Nursery grounds	9,000
Fruit and kitchen gardens, cultivated by the spade	41,000
Pleasure grounds	16,000
Land depastured by cattle	17,479,000
Hedge rows, copses, and woods	1,641,000
Ways, water, &c.	1,316,000
	32,027,000
Commons and waste lands	6,473,000
Total acres in England and Wales	38,500,000

In a late publication of Mr Arthur Young, (*Inquiry into the Progressive Value of Money*, p. 99,) we find the following computation of the change in the rate at which land has been sold at different periods:

	Years purchase.
Sixteenth century	10
Seventeenth century	$16\frac{1}{4}$
1712 to 1737	22
1768 to 1773	32
1778 to 1789	$23\frac{1}{4}$
1792 to 1799	27
1805 to 1811	28

In the same work we find a calculation, in some respects necessarily a matter of guess, of the progressive rise in the price of corn. Classing together three sorts of grain, and taking the No. 20. as the representative of the average price in the seven years preceding 1810, Mr Young computes the preceding proportions as follows:

	Wheat, barley, and oats classed together.
Fifteenth century	3
Sixteenth ditto	5
Seventeenth ditto	$8\frac{3}{4}$
Eighteenth ditto	$10\frac{1}{4}$
66 years, from 1701 to 1766	$7\frac{1}{2}$
(During this period the bounty had been in operation.)	
34 years, from 1767 to 1800	$11\frac{3}{4}$
14 (repeating ten years) from 1790 to 1803	$14\frac{1}{2}$
7 years, from 1804 to 1810	20

II. *Principles of our corn laws.*—We shall now proceed to consider the principal arguments urged in favour of a bounty, and of an interference on the part of government in regard to the corn trade. A bounty, say the writers on the side of the landholders, leads to export, which, while it assures us of plenty at home, has the effect of bringing in money from other countries. Now, the extent of advantage resulting from exports, at least from forced exports, has been discovered of late to be much less than our ancestors imagined. No article will bring money, without having cost an equivalent in one way or other. The money obtained for exported corn, so far from being clear gain, is merely an indemnity for the land, the labour, and the capital applied to it. Had the same land, labour, and capital, been directed to a different purpose, such, for example, as raising hemp or timber, or feeding cattle, the chance is, that the product might have been equally beneficial; and, for aught the advocates of the bounty system can shew, it might have been more beneficial both to the individual and the public. In this, as in other branches of trade, the plain rule is, to let things take their course, and to allow the landholder or farmer to grow whatever article the state of the market points out as most advantageous to him. Viewed in a comprehensive light, it is just as impolitic in government to give 5s. a quarter bounty on the export of corn, as to discourage its export by a 5s. duty. The plea, that corn, being an article of indispensible necessity, cannot be too much encouraged by government, has no foundation in that state of society where the wants of one country can be supplied from another. Recent experience has shewn, how unavailing are the attempts of the most despotic government to interdict the course of commerce. The experiment has been pushed to the utmost, and is not likely to receive a second trial. Europe appears to be again coming round to the state in which each country may account herself at liberty to employ her labour and her capital in the way most conducive to profit, and with little necessity of giving an artificial direction to particular branches of industry, in consequence of political considerations.

Our next argument goes a good deal farther, and will appear not a little extraordinary to the advocates of our corn laws. It is nothing less than that the bounty granted in King William's time, and accounted a signal advantage by our landholders, was, in fact, productive of very considerable injury to them and their posterity. By pushing the cultivation of corn, that is, by throwing into it an extra proportion of labour, capital, and even of land, the matter was overdone, and corn rendered a drug for half a century. To what other cause can we attribute the inferiority of price, already mentioned, in the period of seventy years after the bounty, compared with the seventy years before it, or compared with the course of things since the bounty has ceased to operate? Under such circumstances, needs it be matter of wonder, that there should have been "difficulty in finding a good tenant at the old rent, and that a rise should have never been talked of?" We are far, however, from ascribing similar effects to the other part of the corn laws; we mean the discouragement of the import of foreign grain. Of this, the effect is evidently and incontrovertibly to keep up the price of our home produce. Whether this artificial enhancement is, in the long run, advantageous to the farmer or landholder, is a very different question. We are strongly inclined to doubt its favourable tendency to them; because, as we shall show presently, a rise in the price of corn creates a correspondent rise in the articles on which their income is expended, and with which, in a great measure, their business is carried on. Farther, as the enhancement of corn is unquestionably a national loss, the farmer, and still more the landholder, can hardly escape a portion of the general deterioration. Experience, however, proves, that it is vain to expect men to prefer a remote to a present advantage. The landholders under King William had no hesitation, we have seen, in contending for a bounty, which was to bring them a certain immediate benefit, at the cost of a much larger sacrifice from their sons and inheritors. In like manner, the discouragement of supplies from abroad, seems to absorb all other considerations in the minds of the parliamentary leaders of the country interest at the present day. As the law now stands, it has fortunately no operation until the currency of our wheat falls to 66s.; and if a farther extension be not insisted on, the public are not likely to recur with discontent to that which is past, and is in a manner incorporated with our habits and calculations.

We are now to enter on the arguments for questioning the generally diffused opinion, that a rise in the market-price of corn is advantageous to the farmer and landowner. To make our reasoning on this point intelligible, it is requisite to point out the distinction, and a very important one it is, between money-rent and real rent. When the price of a quarter of wheat has risen from 50s. to 70s. the *money* rent rises in proportion, but, in consequence of an accompanying rise in other commodities, the larger sum of money buys no more of the elegancies and comforts of life than the smaller did before. An increase of *real* rent takes place, when the sum paid by the tenant will buy more of these elegancies and comforts than it did before.

These fluctuations of rent, so different from each other in their effect, originate in very different causes. An increase of mere money rent is caused by the depreciation of money; an increase of real rent is caused by the advanced prosperity of the country.

Let it be kept in mind, that there are three stages in the state of every country: the stationary—the advancing—the declining. The signs of an advancing state, as regards agriculture, are, an increasing demand for corn at home—a gradual diminution, and, finally, a cessation of the export of corn. These signs of agricultural prosperity owe their existence to the prosperity of trade, for the plain reason, that the various hands supported by commerce and manufactures are all consumers of the fruits of the earth. This increase of consumers at home, lessens the necessity of seeking for consumers abroad; so that the diminution of the export of grain, so much regretted by superficial observers, is always a favourable token, unless when caused by a decay of agriculture: a decay which never takes place under a good government. In proof of this, no countries at present export grain largely except North America, which is thinly peopled from being newly settled; and Poland, which is thinly peopled, from having long had an oppressive government.

If we inquire in what particular manner the prosperity of trade enhances land, we shall find that it causes this enhancement in two ways; first as a source of income, and next as a permanent property. It increases the value of income or rent, by multiplying commodities, and also by the still more comfortable effect of reducing their price. The latter consequence is seldom ascribed to commerce, but it does not the less proceed from it. It is the natural result of that progressive augmentation of capital, division of labour, and improvement of machinery, which never fail to accompany an advancing traffic. That rise of prices which of late years has been so remarkable, and which, to hasty observation, seems the consequence of commerce, is in reality produced by very different causes, viz. war, taxes, and the substitution, in various countries, of paper money for coin.

The increased value of land as a permanent property, is denoted by the increase of the number of years' purchase for which it sells. Two centuries ago we had made little progress in trade; the rate of interest was 10 per cent. and the sale-price of land was only ten or twelve years purchase. One century ago, our progress in trade had been considerable; the rate of interest was reduced to 6 per cent. and the sale price of land raised to twenty years' purchase. At present, in consequence of a farther progress in trade, the sale price of land is nearly thirty years' purchase.

Having thus explained the difference between money rent and real rent, and having shewn how greatly the latter is promoted by the prosperity of trade, our next object is to prove, that our corn laws tend to raise money rent only, and have no effect on real rent.

The price of food regulates, directly or indirectly, the price of all other things. This is proved as follows: The component parts of all commodities are three: the raw material—the labourer's wages—the dealer's profit. The price of food regulates that of the raw material, because the raising of such materials, when less profitable than the raising of food, naturally makes room for it. It regulates the labourer's wages, because the wages of the lower ranks are the price of their maintenance. And it regulates the dealer's profit, because that profit is relative to his stock in trade.

the amount of which is determined by the cost of materials and wages,—a cost which we have just shown to be dependent on the cost of food.

The real value of rent, like the real value of every thing else, depends on the quantity of commodities which it will purchase. It is immaterial whether the rent be expended or accumulated, for the rule is applicable to all times, and to all situations. If, therefore, a rise in the money rent of land causes a correspondent rise in the price of all other commodities, the situation of the landlord is the same after the rise as before it. His income, although nominally larger, is of no more real utility to himself in the way of expenditure, nor to his posterity in the way of accumulation. While the supposed effect of our corn laws, therefore, is to enhance the price of one commodity only, (namely corn,) their real effect is an enhancement of all commodities. And this brings us to our last point, namely, the pernicious effects of this enhancement on our landholders as well as on the rest of the country.

If we consider the effects of this enhancement of commodities with reference to our foreign trade, we find, that it lessens our ability to meet the competition of other countries: of countries where the price of labour is not half so high as among us. If we look inwards among ourselves, we shall find, that it contributes to cause a revolution of property to the disadvantage frequently of those who are least able to afford it. This revolution takes place in regard to all money property, whether vested in public or private securities; whether in the funds or in mortgage. All annuitants, in particular, are sufferers by this depreciation. But, to confine ourselves to the consideration of its effects on the landed interest; the discouragement of our foreign trade, and the forced reduction of property at home, are equally pernicious to agriculture. Both these unfortunate circumstances tend to lessen the amount of our capital; to lessen the number of hands whom that capital would employ, and, consequently, the *mouths which would consume the produce of our land.*

It remains that we notice Mr Arthur Young's favourite argument for our present system of corn laws. Without a direct interference by government for the regulation of prices, particularly for preventing them from being greatly lowered by importation, the farmer, he says, would be exposed to frequent discouragement, and would fail in raising the quantity required for our ordinary consumption. In a favourable year, he adds, our prices are low of themselves; in an unfavourable one, we should render them low if we permitted importation; in consequence of which, the farmer would be prevented from sowing extensively, and from carrying improvements into effect; so that, in the long run, a deficiency would take place in the growth, and the country at large would suffer for it.—There are, however, several important considerations in opposition to this opinion of Mr Young. In our climate, under a good system of husbandry, there is little hazard of a *general* failure of the crop. Of our various sorts of grain, several are benefited by that weather which proves injurious to others. In respect to situation, too, the early counties of the south may succeed in securing their harvest, although the autumn may become so wet as to damage the corn in the north. Here we perceive a balance of inequalities operating in counteraction of each other, and, consequently, requiring little aid from the interference of government. Next, as to exempting the farmer from any great or unreasonable fall of price consequent on importation, it is to be observed, that corn is a very bulky commodity; that the freight, insurance, and shipping charges, form of themselves so many distinct taxes on import; and, moreover, that the quality of the grain is more or less liable to deterioration from water carriage. All these circumstances are in favour of the home farmer. They have the practical effect of rendering 60s. a quarter in Britain, a price of no greater benefit to the foreigner than 45s. or 50s. in his own country. Nor is there the most distant prospect of our home growth exceeding our consumption, so as to deprive the British farmer of this important relative advantage. We seem to be already too populous for the productiveness of our soil, and, to judge from the late returns, our population bids fair to go on in a quicker ratio than our improvements in husbandry. The result of these various observations is, that the corn trade may, like any other, be safely left to itself. In this, as in other products, the policy of merchants will provide a remedy for the inequality of the seasons. Sugar, like corn, is dependent on contingencies of weather; yet nobody recommends that government should pass laws, with a view of keeping the sugar market on a level. Merchants, we know, will buy up the article when it falls to a low rate, and, keeping it in store for a time, will bring it to market when the price has become such as to afford a profit. In thus prosecuting his own interest, the sugar-dealer constitutes himself an effectual guardian of that of the public. The case of corn is parallel, and why may it not be left, with equal confidence, to the arrangements of the dealers in corn? The article admits, with due precaution, of being kept from season to season, and it is evidently the interest of the holder to keep back his stock while it is cheap, and to bring it forward when dear—that is, exactly at the time it is wanted. Instead, therefore, of desiring any interference from government, we should merely wish for a final abrogation of the absurd laws against the freedom of corn purchases, or, to borrow the technical terms, against forestalling, regrating, and ingrossing.

The act of 1791, professing to favour the importation and warehousing of foreign corn, permits the same to be landed, but imposes on it when brought forward for home consumption a duty of 2s. 6d. a quarter, in addition to whatever other duties may be payable at the time. Here we have an example of the obstacles placed in the way of the free trade of the corn dealers. The public is under a singular error in suspecting this class of entering into combinations for enhancing grain; for the fact is, that they are often buyers as well as sellers; and in no part of the mercantile body does there exist a greater diversity of opinion. Nor ought we to desire a diminution of the capital employed in the corn trade, when we are apprised that our usual stock, previously to the coming in of a new crop, is equal to only three months consumption, one half of which, at least, is necessary for seed.

It affords some comfort, among the errors which still exist as to the corn business, that the impolicy of small farms is pretty generally acknowledged. These petty occupancies were accompanied by a want of economy both in animal and human labour, while nothing could be less favourable to the advancement of agricultural skill. It is a curious fact, that a century ago, in consequence of our cattle having little other pasture than wastes and commons, the lambs, sheep, and calves, weighed little more than a third, and the oxen considerably less than half of what they weigh at present. It is not generally known that the city of London constructed granaries first at Leadenhall, and afterwards in Bridewell; the former in the beginning of the 15th century, the latter in the course of the 16th. Such deposits may now be safely left to the care of individuals; and one of the greatest blessings attendant on the increased intercourse of nations, in recent ages, is the prevention, as it may be termed, of the occurrence of famine. The stock of one quarter of the world is now so readily transferred to another, that "scarcity and high prices" constitute the extent of an evil, which in former days went the length of absolute privation. Amid all the complicated disadvantages of war and deficient crops, the present age has seen no distress equal to that which afflicted the kingdom in the latter years of Elizabeth.

Among the writers on the side of the corn law system, Mr Dirom, author of the "*Inquiry into the Corn Laws and Corn Trade*," occupies a prominent place. He has been indefatigable in collecting the substance of our various statutes, and in bringing forward the arguments which appear to him to support the plan of bounty on the export of our own, and of a duty on the import of foreign corn. A similar policy is recommended throughout the voluminous labours of Arthur Young. A later writer, on the same side of the question, Mr Mackie, author of "*Letters on the Corn Laws*," directing his attention to the depreciation of money, maintains, that it has been so rapid, that agriculture has derived little protection from the limits prescribed in our late parliamentary regulations. His opponents, on the other hand, would be apt to argue that this fall in money has been the cause of preventing mischief from government interference.

The tenets of the political economists in respect to the corn trade, were distinctly brought forward by Dr Smith; and, in the present day, repeatedly enforced in periodical publications. One of the few practical men who has followed, though not completely, the same course, is Mr Comber, a corn merchant, and author of a late "*Inquiry into the State of National Subsistence*." A small, but very argumentative tract, on the same side, was published in London in 1804, under the title of "*An Essay on the Impolicy of a Bounty on the Exportation of Corn*." (χ)

CORNEA. See Eye, Optics, and Surgery.

CORNEILLE, Pierre, an eminent poet, to whom France is indebted for the first and most essential improvements of her drama. This celebrated name creates more interest in British minds than that of any other foreign poet, because it has been more connected with the rivalship which, in arts as well as arms, has so long subsisted between France and England. In the struggle for predominance which adjoining nations never fail to maintain, the people of each are naturally disposed to prefer the genius which their countrymen have displayed; and by defending their preference on the principles of general taste, to resolve that of their opponents into local prejudice. In this manner, the dispute respecting the comparative superiority of their national dramatists, has been conducted by French and English authors; and whenever an appeal is made by the latter to the productions of Shakespeare, as decisive of victory, those of Corneille are uniformly selected by the former, as supplying more than a counterpoise. In this department, therefore, the contest is, in some measure, reduced to a single combat of the leaders, and the triumph of either champion appears, by a tacit covenant, to secure the dramatic pre-eminence of his nation.

Corneille was born at Rouen, on the 6th of June 1606, eleven years before the death of Shakespeare, and thirty-three before the birth of Racine. His father held the office of warden of the rivers and forests in the vicounty of Rouen, and as a recompence for the services which he had rendered to the crown, received letters of nobility from Louis XIII. Peter, his eldest son, was educated by the Jesuits, and a sense of the benefits which he had derived from the care of that learned and laborious society, inspired him, through life, with the warmest gratitude and reverence for its members. Being called to the bar, he began to practise with little satisfaction or success, and acted for some time as advocate-general in one of the courts of his native city. But though his outset was misdirected, the first impulse of his tender passions turned his genius into its natural path. Perceiving that he had captivated the affections of a young woman, when introduced to her by one of his companions, who was her lover, the incident dwelt so strongly on his mind, that he made it the ground-work of a dramatic essay, which was represented under the title of *Melite*, in 1625, when the writer was only nineteen. Part of the profits which it produced are said to have been received by Hardy, the immediate predecessor of Corneille in dramatic poetry, according to a contract with the managers, by which Hardy engaged to furnish them with new pieces, on condition that he shared the produce of all which were accepted for representation from the pen of others. Though this early attempt of Corneille was much inferior to the productions of his ripe and practised genius, its success with the public, which was so great as to occasion the formation of a new company of comedians, and the delight he had felt in its composition, induced him to persevere in writing for the stage. Corneille was prevented, by the diffidence of youth, from the boldness of forming a style for himself in his first performance. He contented himself with imitating the dramatic practice which then prevailed; and *Melite*, therefore, originally contained many of those indelicacies of sentiment, and even of action, which his predecessors had thought requisite to the popularity of a play, but which he afterwards corrected. This piece being chiefly censured for want of incident, in the next, which was *Clitandre*, he erred in the opposite extreme, but settled at a proper medium in his subsequent attempts. The earliest of these were principally comedies, by which he gained considerable reputation; but having gone to visit M. de Chalon at Rouen, the latter, after a compliment to his genius, told him that in comedy he could expect only a slight and temporary fame, and exhorted him to study the Spanish drama, where he would find subjects which, under management like his, might in tragedy produce the most signal effects. His friend undertook to teach him the Spanish language, and in the mean time to translate for him some passages of Guillelmo de Castro, with which Corneille was so much delighted, that he soon after began his celebrated *Le Cid*, the plot of which that author supplied. The appearance of this piece in 1637 formed an epoch in the history of the French drama, and carried it forward by one of those instantaneous advances to excellence, which are accomplished only by genius of the highest order. The instant and universal success of *Le Cid*, and its superiority to all former specimens of the French drama, inflamed the jealousy of minor writers, and converted into attempts at censure the disposition which they had shewn to applaud its author, when he appeared to rise only a little above the ordinary level. Even the celebrated Richelieu, whose ravenous ambition sought to add poetical to political distinction, could not conceal the chagrin with which he saw his dramatic efforts outshone; and did not blush to engage a host of critics to depreciate a work, which he could not prevent himself from both admiring and rewarding. He thus presented the singular spectacle of a man, who was in some respects the greatest of his age, sinking to unexampled littleness in his feelings of literary rivalship, and labouring insidiously to make the public reverse his own judgment, and condemn him for bestowing rewards, the justice of which was powerfully attested by the envy which prompted so mean and inconsistent a conduct. Of all the attacks upon *Le Cid*, the most able was that of Scudery, who proposed that the French Academy should be umpires in the controversy; and Corneille, probably from the fear of offending so powerful a benefactor as Richelieu, having consented to this reference, the opinion of the Academy was delivered, with admirable address, in a critique which gratified the Cardinal, by admitting the faults of the piece; and the public, by touching them with lenity, occasionally rising into admiration. We have reason to suspect that Richelieu was aided in this disgraceful intrigue by another person of high rank, from the following expression of Corneille, in a letter to one of his friends, concerning the success of *Horace*, which was the next piece he produced; *Horace*, he says, *fut condamné par les Duumvirs, mais il fut absout par le peuple.* The poet, indeed, could not fail to resent the contemptible conduct of his patron, though prudence made him dissemble his indignation, as he acknowledged, after the death of Richelieu, in the following epigram:

Qu'on parle mal ou bien du fameux Cardinal,
Ma prose ni mes vers n'en diront jamais rien;
Il m'a fait trop de bien pour en dire du mal,
Il m'a fait trop de mal pour en dire du bien.

Notwithstanding the powerful efforts to depreciate *Le Cid*, its popularity continued such as to create the proverbial phrase, when the singular perfection of any thing was to be strongly expressed, *Il est beau comme le Cid.* Animated by success, Corneille became a diligent writer for the theatre, and the enumeration of his works is therefore the best record of his life. In the following list we subjoin to each play the date of its first representation. *Melite*, 1625; *Clitandre*, 1632; *La Veuve*, 1634. To the first edition of this play were subjoined complimentary verses addressed to the author by *Boisrobert, Douville, du Ryer, Scudery*, and others. *La Galene du Palais, La Suivante, La Place Royale*, and *Le Cid*, 1637; *Medée* and *L'Illusion Comique*, 1639; *Horace*, 1641; *Cinna*, 1643; *Polyeucte Le Menteur*, and *La Mort de Pompée*, 1644; *La Suite du Menteur*, 1645; *Theodore*, 1646; *Rodogune* and *Heraclius*, 1647. It was in this year Corneille became a member of the French Academy. *D. Sanche d'Arragon*, 1650; *Andromede* and *Nicomede*, 1651; *Pertharite*, 1651. This piece was so much disapproved of that its author became disgusted, and for some years wrote nothing for the theatre. *Œdipe*, 1659; *La Toison d'Or*, 1661; *Sertorius*, 1662; *Sophonisbe*, 1663; *Othon*, 1665; *Agesilaus*, 1666. At this period Racine made his appearance as a dramatic poet, and Corneille perceived a considerable alienation of the public preference, which he had hitherto monopolized. *Attila*, 1668; *Tite et Berenice*, 1671; *Pulcheria*, 1673; and *Surena*, 1675. The admiration which Corneille had procured by *Le Cid* was sustained, and even augmented, by a few of his subsequent productions, such as *Cinna, Horace*, and especially *Polyeucte*; though his genius was so unequal, that most of the rest did not exceed, and some did not reach mediocrity. Such, at least, is the opinion of Voltaire, who says, that only six or seven of Corneille's dramas continue to be represented, and that pardon must be gained by these for above twenty, which, except in a few passages, are the worst of the French plays, not only in point of style, but from barrenness of intrigue, misplaced amours, and wire-drawn dialogues. *Theodore* and *Don Sanche* having been coldly received, and *Pertharite* absolutely damned, their author embraced, from chagrin as has been already noticed, and intimated in the preface to *Pertharite*, a resolution, for which he gave his age as the ostensible reason, of ceasing to write for the theatre. He then took the opportunity of engaging in religious studies, to which he had always been disposed, and translated into verse the treatise of Thomas a Kempis *de imitatione Christi*. This translation, chiefly we presume from the name of the writer, became so popular as to pass through 32 editions; a fact, says Voltaire, as difficult to believe, as it is to read the work. After six years of self-denial, Corneille, was prevailed upon by M. Fouquet, then minister of the finances, to return to the drama, and made a trial of his powers in the *Œdipe*, of which the subject was suggested by his adviser. This piece being received with applause, he continued to indulge his natural bias to dramatic composition, till his 70th year. On his reconciliation with the theatre, he found the public warmly prepossessed in favour of the new character which had been communicated to the drama by Racine. The latter excelling in tenderness and in the plaintive and elegant expression of sensibility, made love the master-passion in most of his plots; but Corneille, conceiving this to be a descent from dramatic dignity, and naturally preferring the style in which he was conscious of excellence, selected fables, where patriotism, valour, and other stern and stately virtues, were the principles of action. The change of taste which his rival had created, by leading him to examine and deny its justice, confirmed his original determination; and instead of following the popular example of Racine, he seems to have rebuked its admirers, by the subjects which he chose for the last series of his productions, and especially by challenging their favour to an exhibition of the savage and ferocious energies of Attila, the barbarian. The people, however, did not relish this defiance; and though the remains of former favour rendered them indulgent to his faults, the epithet of "old *Corneille*," by which he began to be distinguished, proves that, even in his lifetime, they had consigned him to the class of obsolete and unfashionable poets. On finally renouncing the theatre, Corneille employed all his thoughts in preparing himself to die like a Christian; and for this pious duty he was allowed more leisure than he had a title to expect, as his death did not happen till the 1st October 1684, when he was in his 79th year. The respect which he enjoyed had previously been shewn, by his election to the Deanry of the French Academy; and his *eloge* was pronounced before that dignified body, by his amiable and admirable dramatic rival. Many other encomiums were contributed by his eminent contemporaries; and if *laudari a laudato viro* be the best attestation of worth, if excellence may be estimated from the excellence of those by whom it is praised, what posthumous honour can be greater than his of whom the biographer was Fontenelle, and the eulogist Racine?

In the private character of Corneille there seems to have been nothing extraordinary. From his writings we may infer that he was a scholar, and that he was abundantly skilled in the literature and history of the ancients. He seems to have been partial to the Romans, whose lofty sentiments and masculine rigidity of heroism he took a peculiar delight in conceiving, and clothing with poetical expression. Seneca, Lucan, and Statius, whose two first Thebaids he translated, are said to have been his favourite authors, which shews that he was less offended with the occasional affectation than with the absence of that stoical grandeur of thought, which these writers seem perpetually straining their genius to produce. Corneille was also well acquainted with the *belles lettres* and criticism; but all his studies were made subservient to his ambition of dramatic excellence. In person he was of a good size; in countenance agreeable and strongly marked, especially by the vivacity of his eye; in manner plain and simple; and in dress unaffected or even slovenly. To elocution he had few pretensions, and in reciting his own verses, though emphatic, he was ungraceful. In conversation, he was neither elegant nor interesting, and disappointed the expectations which might have been formed from his writings. He was one of that high order of poets, whose faculties are elevated at times to a measure of exertion too violent to endure, and in whom extraordinary activity requires corresponding repose. He was an example therefore of that unaccountable disparity, which Professor Stewart had remarked in the case of other poets, between their general powers, and the inspirations of their more favoured moments. But though the conversation of Corneille had few attractions, his dramatic celebrity was sufficient to render his society an object of eager desire in the most polished circles. In France, at that period, the most fashionable manners were supposed to include a certain portion of literary taste. Where this did not exist, it was pretended, and the pretence maintained by a shew of enthusiastic admiration of men of genius, who were thus secured from that neglect to which they are destined in countries where no such fashion prevails. Corneille, therefore, as the father of the drama, and the boast of the nation, had his choice of society, and the most illustrious assemblies of *noblesse* felt themselves receiving, rather than conferring, distinction by his presence, which they thought would be interpreted into an authentic acknowledgment that they possessed, not only the titles, but the accomplishments of their rank. His pieces were frequently read before representation at the *Hotel de Rambouillet*, to a circle of courtly critics; and we learn from Madame Sevigné that, even in his old age, he continued to gratify the celebrated characters of the day, with the first communication of his works. "Nothing," says that accomplished lady, "will ever come up to the enchanting passages, we meet with in Corneille. He read us, the other day, at M. de la Rochefaucauld's, a piece of his which shewed what he had once been. It cost me many tears." (Letter 124.) "Corneille," she says again, "has read a piece of his to amuse Cardinal de Retz. It reminds me greatly of the beauties of the ancients." (Letter 139.) Such was the veneration which Corneille enjoyed, and such the pleasure he could impart, at an age when the power of giving pleasure is generally extinct. In his moral character he seems to have been unexceptionable, and to have escaped the singularities in which genius too frequently thinks itself privileged to indulge. He was an exemplary husband, father, and relation; and the keen sensibility, which enlivened his representation of the heroic passions, gave him a warmth of manner, in asserting his independence, which approached occasionally to roughness; for he had from nature a loftiness of spirit, and disdain of supple servility, which, in his Roman characters, enabled him to paint from himself. He had a rooted aversion to business, in consequence of which, though he received considerable sums for his writings, he never was rich. His means of subsistence were derived chiefly from his pen; and in his latter years, from a pension granted by Louis XIV. This was, at one time, about to be withdrawn, which Boileau prevented, by offering to relinquish his own pension in favour of the venerable dramatist This offer, so honourable to Corneille, does no less honour to Boileau, who, though warmly attached to Racine, was ready to have made so great a sacrifice for the rival of his friend. Corneille was deterred, both by his taste and by his principles of religion, from copying, except in his first attempts, the licentiousness of his predecessors; and the French stage is thus indebted to him for exalting its character, both by the moral and poetical superiority of his compositions

In considering his genius, its extent must be estimated from the best of his works, and from the state at which the art of poetry had arrived, when he began to write. The last criterion is peculiarly important; for it often happens, in art as well as science, that the previous approaches to some capital invention have been so close, as to entitle its author to the praise, rather of a fortune, than of an ability superior to his predecessors. In each step there may have been equal difficulty; but to him who makes the last, by which some augmentation is produced to human enjoyment, the triumph is reserved. Where excellence, therefore, has been attained without the help of such preparatory approximations, a mental effort must have been made, proportioned to this defect; and Homer, Milton, and Corneille, may claim a double share of admiration, as having reached, in the earliest age of their national poetry, a perfection which none of their successors have maintained. Before the appearance of Corneille, the French drama was in so rude a state, that the names of Jodelle, Garnier, and Hardy, who immediately preceded him, are preserved chiefly to illustrate the extent and rapidity of his improvements. He first conceived the idea of following the rules and examples of the ancients, and of applying them to a greater variety of subjects; and even in his initiatory attempts, this conception was executed with success. Comedies, consisting chiefly of farcical mistakes, without the slightest attention to manners, character, or plot, and tragedies no less unskilful in design than flat in composition, our author superseded by productions, which, addressing the most universal feelings of nature, were equally interesting to the highest and the lowest of the auditors. Corneille seems to have delighted in the conflict of the most powerful passions; and when he gives the triumph to those which, in ordinary characters, are weakest,—when he makes the desire of avenging a departed parent overcome the most ardent affection for a living lover,—he shews a confidence in his genius, which was justified by success. A drama is the relation, in dialogue, of some extraordinary occurrence.

by which minds of singular force are placed in situations which call all their energies into full exertion; and it is partly from a natural curiosity to see how human beings will acquit themselves in the most trying and unusual circumstances, that the eager attendance on tragical spectacles, both real and fictitious, must be explained. Corneille excelled in conceiving characters of the most exalted heroism, and in making them express their majestic sentiments in language of corresponding magnificence. It is to be doubted, however, whether he does not impair our sympathy with some of his heroes, from carrying their magnanimity beyond what is warranted by the imperfect nature of which we are conscious, as we sympathize chiefly with conduct which we suppose might, under similar circumstances, have been our own. The sententious grandeur, too, and the antithetical brevity, in which his speakers couch their lofty ideas, may sometimes appear more like the language of laborious study, than the artless and sudden expression of vehement emotion. His countrymen, however, will perhaps not allow these objections, as they are still so prone to the imitation of the ancient sentimental apothegm, and so prompt in pointing it with felicity, that what a foreigner conceives to be too artificial, may be a just representation of human nature, under the peculiar modification which it has received from local character: and critics of a different nation should remember, that it is not from the study of *human* nature only, but of *French* nature also, that mankind will be delineated by a dramatist of France. Corneille is charged with slovenly versification, and metrical negligence; and he is certainly far from equalling the delicate suavity of Racine, or the minute exactness of Boileau. This may, however, be partly explained by the priority of his appearance, in an age when the improvements of style were singularly rapid. The sublimity of those passages which he frequently produced, would appear to their author, as they did to others his contemporaries, an apology for the imperfection of others in which he took less interest, because he had been less successful. "The piece," says Madame Sevigné, speaking of Racine's Bajazet, "has doubtless its beauties, but none of those strokes, that, like Corneille's, make one tremble. Let us forgive the bad lines we meet with in the latter, for the sake of those divine sallies that so often transport us, and bid defiance to imitation."

In comparing Corneille with Shakespeare, we must recollect, not only that the latter was born half a century before the former, but also that, even if his appearance had been deferred to the end of that period, the art of composition was more advanced in France than in England during the age of Corneille. In testimony of this, we have to remark, that, in every country, the improvement of style generally begins in its poetry, and is slowly communicated to its prose, and that the prose writing of Corneille differs less than that of his English contemporaries from the present language of their respective countries. To this we must add, that Corneille had all the aid of a classical education, of which Shakespeare was comparatively destitute. Under these disadvantages, though the latter be inferior in critical disposition and design, he is surpassed by none in the successful boldness of his portraiture of character, in luxuriance of invention, in combining novelty of conception with fidelity to nature, and in the irresistible power with which he absorbs the attention, and agitates the passions. The favourite heroes of Corneille display a magnanimity, of which the probability is perhaps impaired by our sense of human weakness; while those of Shakespeare excite a keener sympathy, from the leaven of infirmity which is mingled with their virtues. The inflexible heroism of the former is a more obvious and manageable idea, than the intricate and interesting struggle of sensibility and indecision in the character of Hamlet, or the blaze of regal virtue, emerging from the eclipse of early dissipation, in that of Henry the Fifth. Corneille exhibits nothing in tragedy, at once so extraordinary and so natural, as the progressive wickedness of Richard or Macbeth; and in comedy, nothing so amusing, yet so conceivable, as the mirthful profligacy of Falstaff, or the engaging peculiarities of Fluellen. Corneille sustains the grand but simple characters which his mind had created, through a short transaction, with masterly skill: while those of Shakespeare, though of a more delicate and singular mechanism, are conducted, with apparent ease, through a long succession of situations, by which all their involutions are artfully unfolded. Corneille proceeds, with a straight majestic step, on even ground; but Shakespeare delights to force his way amid tortuosities and obstructions, and to surmount them all. Corneille has been said to represent men as they should be, and Racine as they are; but the last of these encomiums belongs with more propriety to Shakespeare. Corneille seems to have studied human character in books or in reflection, and Shakespeare in the experience and observation of real life. The sentiments with which Corneille supplies his interlocutors are splendid and impressive, but appear occasionally couched in a style too rhetorical for the sudden effusions of unstudied dialogue; while those of Shakespeare grow so spontaneously from the occasion, and drop from the speaker with such prompt felicity, that we imagine the speech would have been incomplete without them. In the conduct of their fables, Corneille is betrayed into errors by his adherence to the unities, and Shakespeare by his neglect of them. The former crowds his incidents into too narrow a space; and the latter, in lengthening the intervals between them, forgets that they were to be accommodated to dramatic representation. Both poets excel in bringing their characters into situations, which create the most violent conflict of the passions; yet the struggle of Cinna between loyalty and love, or of Polyeuctes between religious enthusiasm and conjugal affection, is at least not superior to that between the remorse and ambition of Macbeth, or the jealousy and tenderness of Othello. Corneille sometimes mistakes the description which would suit a spectator, for the natural expression of a passion in one who speaks under its immediate impulse; while in Shakespeare, the passions are recognised in the agitated accents of their victim, as readily as the existence of pain is inferred from the cry of the sufferer. In language, Corneille must be allowed a negative preference; as he never descends to the quibbles and conceits to which Shakespeare could not, for ten lines together, resist the temptation; but the positive pre-eminence of the latter might be demonstrated by innumerable passages, which his rival has never equalled. In the invention of imagery, Corneille is more correct, and Shakespeare more original. No simile of the former is at once so touching, so graceful, and so new, as that by which a female concealing her love, is painted by the latter:

> "She sate like Patience on a monument
> Smiling at Grief."

There is one department in which no comparison can be stated, as it is unattempted by Corneille, but in which it seems hardly possible that Shakespeare should have been surpassed. We allude to the invention of preternatural agents, or what, in epic composition, has been termed *machinery*. When Shakespeare wrote, the public mind was in that state of juvenility, which delights in ascribing to miraculous powers those appearances which its rude philosophy is unable to explain. This popular predilection Shakespeare was obliged to indulge; but he did so in a manner which, instead of debasing, bestows additional interest and ornament on his productions. His fancy gives a new character to the ideal beings of the vulgar mythology, and enriches it with others of his own creation; nor do we think the ingenuity of Corneille could have produced such a visionary offspring as the fairies and the ghosts, or the Ariel and Caliban of Shakespeare. From this comparison, we hope to escape the charge of a childish nationality, if we conclude with assigning the palm of genius to Shakespeare, and that of art to Corneille; and with admiring the varied and extensive powers brought into action by the former, and the scientific skill with which a smaller portion is disciplined and arrayed by the latter. (W)

CORNET STOP, in Music, is the name of a compound set of pipes on the organ; in the use of which, each finger-key acts upon and occasions five different pipes to sound at the same time, viz. one which is tuned unison (I) with the proper note of such finger-key, (and with the same note of the diapason stop), another is tuned a true IIIrd above this, another a true Vth, another an VIIIth, and the uppermost a true XVIIth above the lowest. This stop is usually, in church organs, only a *treble* or *half-stop*; that is, its lowest note is the tenor-cliff C, or at most the bass-cliff F: and from being most frequently used (with the diapason) in interludes between the verses, or in giving out the psalms, in the English churches; some organ concerto players have also used it, and hence it is also called a *solo* stop, as well as because it is not used in chorus or the full organ for want of a bass, unless that the SESQUIALTERA, another compound stop, or such organ, is divided into two parts at C or F, so that the lower part can be drawn along with the cornet, and its own upper half omitted for the sake of variety. Dr Smith remarks, that the best tuning cannot wholly prevent these very compound stops from battering the ears with a constant rattling noise of beats. See COMPOUND *Stops*. (e)

CORNICE. See CIVIL ARCHITECTURE.

CORNIDIA, a genus of plants of the class Octandria, and order Trigynia. See BOTANY, p. 206.

CORNU AMMONIS. See AMMONITES.

CORNUCOPIÆ, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 102.

CORNUS, a genus of plants of the class Tetrandria, and order Monogynia. See BOTANY, p. 124.

CORNUTIA, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 254.

CORNWALL, is the county which forms the south-western extremity of Great Britain. The Land's-end, which is its western termination, lies in latitude 50° 5′ north, and in longitude 6° 0′ west. Its most southern point is the Lizard, which lies in latitude 49° 57′ 30″ north, and in longitude 5° 15′ west. This county is surrounded every where by the sea, except on its eastern side, where it is separated from Devonshire by the river Tamar, and an artificial boundary of a few miles in length at its northern extremity. On the south it is washed by the British channel, and on the north by the Bristol channel, so that it forms nearly a complete island. Its form is nearly that of a cornucopiæ, and, from its resemblance to a horn, it seems to have derived its original name in the British language, *cernyn*, which signifies a horn or promontory. The north-eastern angle of the parish of Morvinstow, near the source of the Tamar, to the east, and the Land's-end, in the parish of Sennan, to the west, are the two most distant points of Cornwall: measured in this direction, in a line nearly south-west and north-east, its length is seventy-eight miles and a half. Its widest part, from Morvinstow on the north, to the Ramhead on the south, is rather more than forty-three miles; but this width rapidly contracts, and its medium width, between Padstow on the north, and Fowey on the south, is about eighteen miles: if measured from Mounts-bay on the south, to Heyle river on the north, its width does not exceed four miles. Its circumference is estimated at 210 miles; and, according to Martyn's map, which was drawn from an actual survey, the whole area contains 758,484 statute acres, or 1185 square miles. It is divided into the following hundreds: Shalton, east, west; Lesneeoth, Trigg, Pyder, Powder, Kirrier, and Penwith.

Climate.

The climate of Cornwall is damp and uncertain: the winters are, in general, mild and open, and the summers cool and cloudy. For nearly three fourths of the year, the wind blows from the intermediate points between the south and the west, and consequently sweeping over a large tract of the Atlantic ocean, they bring vast bodies of clouds, which being broken by the hills, descend in frequent showers. It is observed, however, that the rains are not near so violent in this county as in many other parts of England; and the moisture of the climate is as much owing to the fogs as to the showers that fall. The winds are often changing from one quarter to another with great violence; and this circumstance, though it increases the mutability of the weather, prevents those stagnations of damp air which are so prejudicial in some wet countries. On the north side of the county, the north-west winds are extremely violent and desolating, but they are generally dry, and bring fair weather. In consequence of the saltness of the atmosphere, and the violence of the winds, the most hardy trees are very stinted and unhealthy in their appearance near the sea-shore: and the salt spray of the sea is sometimes driven with such violence as to destroy the crops of wheat and turnips. Most of the trees and shrubs lean to the eastward, and have the appearance of being clipped by the gardener's shears. Notwithstanding the unfavourable nature of the climate of Cornwall, its southern latitude, and the prevalence of the south-west winds, give it such a degree of mildness, that geraniums, myrtles, and other tender shrubs, thrive uncommonly well in the open air. The surface of this county is, with very few exceptions, very unequal. The ridge of bare and rugged hills which runs through its whole length, is however intersected and broken by some picturesque and fertile valleys. The highest hills are Carradon, Roughter, Brown Willy, and Heresborough, but none of them deserve the name of mountains. The height of Brown Willy above the level of the sea at low water, according to Major Mudge, is 1368 feet.

Soil.

The soils of Cornwall are of three descriptions: the black growan, or gravelly; the shelfy, or slaty; and the loams. The first consists of a light mossy black earth, intermixed with small particles of granite, cal-

Cornwall. led *growan*, from *grow*, a Cornish word, signifying gravel: this soil is found principally in the western parts of the county. The slaty soil is the most abundant: it is formed of schistose matter, mixed with loam. The pure loamy soils are of no considerable extent; they are found principally on the low grounds, declivities, and the banks of the rivers. From this description of the soil and climate of Cornwall, it will appear that it is one of the least inviting of the English counties. The

Rivers. rivers in Cornwall are all small: the principal are the Tamar, and the Camel: the former rises on the summit of a moor in the parish of Morvinstow; it follows a southern direction, with very little variation, for nearly 40 miles, when it falls into the harbour of Hamoaze. The Camel, which is the largest river on the north coast, has two sources, one near Camelford, the other near Roughter: The streams join below Kea-bridge, and from Wade-bridge to Padstow harbour the river is navigable. Besides these rivers, there are the Lynher, the Loo, the Fawy, and the Fal. At the mouth of the Loo, there is a curious fact; the river forms a kind of reservoir, at a little distance from the sea, from which the water runs into the sea by a subterraneous passage: at no time of the year is the water in this pool salt, or even brackish.

Property, leases, &c. Property is very much divided in Cornwall, so that there are no estates of any considerable size. The tenure of land, for the most part, is freehold; some is held of ecclesiastical corporations; and the ancient duchy land is held under the Duke of Cornwall, as copyhold in fee, subset to a small annual rent. Formerly leases were often granted for lives, for a term of 99 years, determinable on the death of the longest liver of three lives; the landlord, however, consenting to add a new life, on the death of one of them, on the payment of a fine of from 14 to 18 years rent. This kind of lease is now on the decrease, except in cases of miners, who enclose patches of the waste land to the westward of Truro, granted to them on the condition that they build a cottage, and pay an annual rent of ten shillings.

Agriculture. In an agricultural point of view, Cornwall presents very little worthy of notice. Its implements are very various, but few of them are peculiar to it. The Cornish waggon, or wain, however, may be recommended, as being extremely well adapted for carrying corn and hay in harvest time. The old Cornish plough is a rude and simple instrument, which still maintains its ground in many parts of the county. In the lower parts of Cornwall, corn is thrashed on *barn boards*, raised above the level of the barn floor, each plank being about the third of an inch from the next to it, so that the grain falls through it, and is not bruised as in the usual manner. In some parts, the wheat is beaten out by women on a barrel, or inclined plane. The term *hedge* is applied to all kinds of mounds or fences, of which there are three sorts; stone hedges, made of coarse slate, which are principally on the western part, and on the sea-coast; earth hedges, capped with stone, &c. on the moors, and in the country round Camelford; and the common hedges, which are most usually met with on the eastern part of the county. Nearly one third of the cultivated land is under the plough: the crops generally grown, are wheat, barley, and oats. The *arena nuda*, which in Cornwall is called *pilez*, is sown in the western district. This grain is smaller than the common oat, and the straw much more delicate, so as to answer for feeding horses and cattle nearly as well as hay: this kind of oat is steamed with potatoes, and used for fattening pigs. The soil and climate of this county are particularly favourable to the growth of potatoes; and a very large portion of the tillage land is annually planted with this valuable root, the cultivation of which is carefully attended to and well understood. The uninclosed waste lands in Cornwall are computed at nearly 200,000 acres, the greatest part of which serves no other purpose than to afford a scanty pasturage to a miserable breed of sheep and goats. The agricultural produce would be much more limited than it actually is in this county, were it not for abundant supplies of three valuable manures, two of which, as almost peculiar to it, deserves to be noticed; these are fish and sea-sand; the third, seaweed, is used in many other parts of the kingdom. Bruised and small pilchards, called "*caff*," are buried in a pile of earth, where they are permitted to lie for some months before they are laid on the ground: sometimes the fish are used alone. The liquor which drains from them while under the process of curing, is also deemed a valuable manure. The sea-sand of Cornwall is found to be very fertilizing, containing in general a great quantity of calcareous matter; and some of it, a slimy earthy matter, called *lig*, or *liggair*, which is applied to potatoes. The sand, which is in the highest estimation, is found near Falmouth; it is frequently carried fifteen miles inland, on horses, mules, or asses, about 2 cwt. called a *seam*, being the burden for each animal. This sand has a more immediate, as well as a more permanent good effect, on the moor-lands, than on the loamy soils, and is therefore very valuable when found in the vicinity of them. It is reckoned that 54,000 cart loads of sand are carried from Padstow harbour alone, and that the expence of land carriage for it, in the whole county, amounts to L. 30,000 per annum. Lime is found only in two places, in the parishes of South Petherwin and Veryan: the Veryan limestone contains a considerable quantity of manganese and oxide of iron, and is more valuable as a cement than as a manure.

Cattle. Few of the native cattle of Cornwall are now in existence; they are very small, of a black colour, short horned, coarse boned, with a large proportion of offal, at the same time very hardy: they have been superseded by the genuine north Devon. The practice of letting cows out to labourers and poor people, is not unusual among the farmers; the hirers have the milk and butter; the farmers the calves. Oxen are much employed in agricultural labour, being worked from three to seven or eight years old, and regularly shod.

Sheep. The native sheep, like the native cattle, have nearly disappeared. Carew, in his Survey of Cornwall published in the beginning of the 17th century, describes them as having little bodies, and coarse fleeces, so as their wool bore no better name than Cornish hair, and hath from all ancientry been transported without paying custom. On the sand hillocks on some parts of the north coast, there is a small compact sheep, the mutton of fine flavour, and the fleece nearly equal to that of the South Down. These sheep have been observed to feed greedily on the small turbinated shells, which come out from the sand, in the mornings and evenings.

Mines. Cornwall is celebrated for its mines, of which there are generally about one hundred of different kinds wrought. Of these, in 1800, when an accurate map of the mines was made by Mr William Phillips, there were 45 of copper, 28 of tin, 18 of copper and tin, 2 of lead, 1 of lead and silver, 1 of copper and silver, 1 of silver, 1 of copper and cobalt, 1 of tin and cobalt, and 1 of

Cornwall. Mines.

antimony; since that time, some mines of manganese have been opened. The copper and tin, either singly or combined, forms at least four fifths of the mines of Cornwall, and are met with near the junction of the granite and grauwacke. Tin, when not combined with copper, generally forms a part of the granite; and often, in this case, wolfram is found in the matrix of the vein. Tin is found combined with sulphuret of lead in the mine of Heavas, in the parish of St Mewan, which is a rare and anomalous occurrence. It is accompanied with arsenical pyrites, copper pyrites, and blende, in the mine of Trerascus and other places. Sulphuret of antimony was formerly worked in different parts of Cornwall, but these workings are now given up. There are two mines of manganese, one on the road from Bodmin to Truro, and the other a mile to the south of Launceston. They are very productive; the one is shipped for Lancashire, where it is used in bleaching cotton. The lead mines are confined to the low parts of the county: galena, in large cubes, is found at Tresearen, united with copper pyrites; at Poldice, mixed with the same and arsenical pyrites; and at Penrose, a rich vein of it opens to the surface. So various are the mineral productions of Cornwall, that, with the exception of platina, mercury, molybdena, tellurium, tantalium, columbium, and cerium, it affords indications of all the other known metals.

Tin and copper.

But the principal mineral products of Cornwall, are tin and copper. These metals are generally found in veins and fissures, which are here called *lodes*; one side of the fissure is sometimes a dense stone, and the other a soft clay. The direction of the fissures is commonly east and west; sometimes they are perpendicular, but more frequently dip to the right or left as they descend. Their course is seldom in a straight line, and it is remarked that their bendings form larger angles in crossing a valley. Tin is found either collected and fixed, or loose and spread about; in the former state, it is either in a lode or in a horizontal layer; or interspersed in panes and small masses. It sometimes happens that a lode which runs perpendicular for several fathoms, suddenly changes into a horizontal layer. Tin, in its dispersed form, is met with either in a pulverised state in separate stones, which are called *shodes*, or in a continued course of such stones; this course is called a *stream*. The Toth stream works were formerly the most considerable and valuable in Cornwall, but they were all washed away by the sea in the year 1801. The Carnon stream works are now the most extensive; they occupy a portion of ground nearly one mile in length, and 300 yards broad; the whole of which space appears to have been gained from the sea. From the nature of the stream works here, and in other parts of Cornwall, there can be little doubt that the accumulations of ore found in them, have been originally true veins, worn down and removed by some cause or other from the place where they were found, and covered by alluvial soil.

As soon as the ore is raised from the mines, it is divided into as many shares as there are lords and adventurers, and these are measured out by barrows, an account of which is kept by a person who notches a stick. Every mine has the right of having her ore distributed on the adjacent fields. Stamping mills are generally erected on the spot where it is pounded; to assist this operation, a rill of water keeps it constantly wet, and it is carried by a small gutter into the *fore pit*, where the heavier particles settle, the lighter ones being carried forward to the *middle pit*, and from that into a third. It is afterwards washed in a large vat, and made sufficiently clean for the smelting house. If the mine is of great extent and importance, the people employed are divided into certain classes: The foreman, or captain as he is called, allots each workman his task, pays them their wages, and keeps the accounts: the underground captains inspect the works in the mine, take care that the ladders, ropes, &c. are in good repair, and overlook all the different objects connected with the working of the mine.

Both the *stream* and *lode* works lie either in *severall* or in *wastrell*, that is, in enclosed pounds, or in commons; in the former, no person can search for tin, without the permission of the lord of the manor; but, in the latter, it is lawful for any man to make trial of his fortune that way, provided he make an acknowledgment of the right of the lord of the manor, by giving him a certain part of the produce, which is called the toll. The *wastrell* works are reckoned among chattels; and when a mine is found in this situation, the discoverer endeavours to ascertain how far it is likely to extend; at the supposed limits, he digs up three turfs; (which is termed *boundary*,) and within these every other person is restrained from searching.

All the tin ores are wrought into metal in the county, and afterwards cast into blocks, from two hundred and three-quarters to three hundred and three-quarters each. Before these can be exposed to sale, they must be assayed by the officers appointed by the duke, and stamped by a hammer with the duchy seal: this is denominated *coining the tin*. The original stannary towns to which the tin was carried to be coined, were Launceston, Lostwythiel, Truro, and Helston; but, in the reign of Charles II. Penzance was added, for the convenience of the miners in the western part of the county. The coinages are held regularly four times each year, at Lady Day, Mid-summer, Michaelmas, and Christmas. The annual produce of the tin mines varies from 25,000 to 30,000 blocks; the value of each block is, on an average, generally about L.10.

It is generally supposed, that the tin mines of Cornwall were wrought, or visited by the Phœnicians and Greeks: the Romans also probably did not neglect them, while they were in possession of this island. During the dominion of the Saxons, they were neglected; and even in the reign of King John, the *tin farm* amounted only to 100 merks. At this period, the Jews had the sole management of them. In the 18th of Edward I. the mines were again neglected, in consequence of that monarch banishing the Jews. Soon afterwards, a charter was granted to the gentlemen of Blackmoor, by Edmund Earl of Cornwall, granting them several privileges in the working and management of the tin mines; and, in consideration of these privileges, they bound themselves to pay to him and his successors, Earls of Cornwall, the sum of 4s. for every hundred weight of white tin; and on this occasion the stannary towns were first fixed. This charter was confirmed in the 33d of Edward I. The tinners of Cornwall were made a distinct body from those of Devonshire, and the privilege of having a coinage both at Mid-summer and Michaelmas was granted them. Several acts were afterwards passed, confirming and enlarging these privileges: by them the society of tinners was divided into four parts, under the superintendence of one warden, with an appeal from his decision to the Duke of Cornwall. The lord warden is empowered and instructed to appoint a vice-warden, to determine all stannary disputes every month. Stannary courts are also directed to be held by four stewards, appointed by the lord warden, where causes are decided by juries of six persons.

As the copper mines of Cornwall, though numerous and productive, are not peculiar to it, they do not require particular description. We shall, therefore, proceed to notice those appearances and productions of this county, which are most interesting to the geologist, the mineralogist, the botanist, and the natural historian. This county may be considered as formed of a chain of low mountains, stretching from E.N.E. to W.S.W. The central and highest part of this chain is granite, extending into a narrow mountain plain at the north-eastern extremity, and, at the other extremity, gradually contracting into a ridge; on each side of the granite, grauwacke is found: both sides of this chain have nearly the same inclination, the rivers on the one side running into the British, and on the other into the Bristol Channel. The grauwacke formation occupies a very considerable extent in Cornwall: on the southern side of the chain, it is found from the mouth of the Hamoaze to that of the Huel, a space of about 40 miles from east to west. The Cornish miners give the name of killas to a variety of grauwacke slate, which is very abundant in this county, which is smooth to the touch, though not unctuous; the colour varying from dark-grey to white; the lustre silvery, and the structure schistose: it is very rich in ore. The grauwacke continues uninterrupted from Lynhercreek to the north, till we approach Kelt-hill, near Callington, where its termination is indicated, by the quantities of quartz lying on the road. In the neighbourhood of Kelt-hill, an adventitious mass of tourmaline, of a cylindrical form, has been found, which the Count de Bournon considers a new variety of form. In the neighbourhood of St Stephen's church, the *killas*, or grauwacke slate, passes into the slate of common grauwacke; and its termination, on this side, is indicated, by its being stained with oxide of iron, and mixed with numerous veins and pebbles of quartz. Near this place, decomposed granite, in the state of *kaolin*, or China-stone, as it is here called, is found: its qualities were accidentally discovered about 50 years ago, by a gentleman who was present at the founding of some bells at Fowey, and noticed the appearance of some of the earth, which had been contained in the mould. Great quantities of kaolin are sent by sea from Charlestown, for the use of the Worcestershire and Staffordshire potteries. It has also been manufactured at Truro, into retorts and crucibles, of an excellent nature for resisting fire. The next formation of importance, which succeeds the grauwacke in Cornwall, is the serpentine, which stretches from the neighbourhood of Treelevor, by Ruan Mager, as far as Corner Pradanack, including the promontory called the Lizard Point: in this space, there are two formations of rocks, in subordinate beds, and of different natures, the one mica slate, to the S.S.W. of the village of Lizard; and the other the soap-rock, to the north of Kinance Cove. The colour of the latter is whitish, or straw-yellow, streaked with red, green, and purple: it is soft and wet when first taken out, but soon becomes hardened: it is found of three degrees of purity; the first, called the *best-best*, is uncommonly white. This kind is used in the manufacture of porcelain, as it contains, naturally, the same proportions of magnesian and argillaceous earth, which are artificially mixed, for the purpose of manufacturing the finest Worcester China. The whole soap-rock is rented by the proprietors of the porcelain manufactory in that city.

The mineralogist will find many rare and curious specimens in this county: some of them have been already incidentally mentioned. The following also deserve notice: Green carbonate of lead and apatite, near Heslton; blende, in twenty sided crystals, and green fluor, in twenty-four sided crystals, at St Agnes; crystallized antimony, with red blende on quartz, at Huel Bays; yellow copper ore and opal, near Roskier; and arseniate of copper, in cubes of a bright grass-green colour, from Huel Carpenter. Formerly *wood* tin, as it is called, was found at Poth in great abundance, but it is now scarce: in colour it resembles *hæmatites*, and is finely streaked like radiated zeolite. It is so hard as to emit sparks with steel, and, when broken, has a fibrous appearance. According to Klaproth, it yields more than sixty-three parts of tin in a hundred. The *elvan* stone of the Cornish miners is also found at Polgoth: it is a greenish, or cineraceous granite, with some *steatites* intimately blended with the quartz, mica, and felspar. Under some of the granite rocks, which project from the shore near Pengerswick, there is an extremely hard, black, schistose substance, apparently a species of hornslate: a similar species, with their veins, of a whitish colour, between the laminæ, may be seen near St Roche. The Cornish moor-stone, a very close species of granite, that takes a good polish, and is applied to a great variety of purposes, is found abundant near the Land's End: it is split, by applying several wedges to holes made on the surface of the stone, about three or four inches from each other; and it is remarked, that the harder the mass, the more easily and regularly it is cut: it is sometimes used for posts, instead of wood, in pieces of from 14 to 15 feet in length, and not more than six inches thick. In the Gwennap mines, to the south-east of Redruth, the substance called *gossan* abounds: it is of a reddish or yellowish brown colour, amorphous, and principally composed of oxide of iron, mixed with argillaceous particles: it is regarded by the miners as indicative of the neighbourhood of a rich vein. In Caharrack mine, red, vitreous copper ore, with octahedral crystals, and some varieties of arseniate of copper, are found. It is also said, that asphaltum has been found in this mine, at the depth of 90 yards. At Huel Unity, black fuliginous copper ore, a very rare mineral in other countries, is found; and at Huel Jewel, the substance called *growan* by the miners. It is now, however, become extremely scarce: it is a granite, consisting of transparent glassy quartz, a small portion of felspar, and mica in a decaying state. The crystals of tin which this substance contains are in tetrahedral pyramids, and of a colour like rosin; wolfram is also distributed through the mass. In one of the mines near St Agnes, the sulphurated ore, discovered by Raspe, was dug. He proposed to call it bell-metal ore: according to Klaproth, it contains, out of 119 grains, 30 of pure sulphur, 41 of tin, 43 of copper, 2 of iron, and 3 of the stony matrix. Its colour is like that of the grey copper ore, its texture lamellar, and it is extremely brittle. In one of the tin lodes of Polgoth mine, the *schiefer spar* of Werner was discovered some years ago. On this circumstance, Dr Maton remarks, "calcareous substances are very scarce in Cornwall; and I was not a little surprised to hear, that the schiefer spar (which is one of the scarcest species, and had never been before found, but at Konigsberg, in Norway, and in Saxony) was a na-

Cornwall. tive of this county. I am informed, that the Rev. Mr Herneth of St Austle is in possession of a crystallized variety, with erect hexagonal plates." The miners remarked, that from the period of the discovery of this substance, the lode ceased to be productive. The Denyhall slate quarries, near Camelford, produce a species of slate of a peculiar texture; if it is struck, the sound it emits is almost as clear as that of metal: its colour is greyish blue: it splits into *laminæ*, sometimes sufficiently large for grave-stones: it is equal to any slate in the kingdom for roofs. The *Cornish diamonds* must not be passed unnoticed. They consist of beautifully transparent quartz, in six-sided pyramids, with a hexagonal prism. Their specific gravity is from 2.64 to 2.67. They are composed of the purest siliceous earth: some of them are colourless; others stained with metallic oxides. The most remarkable and rare kind have hexagonal sheaths, described one within the other,—a structure which has puzzled geologists. In a copper mine near Redruth, a curious substance, called the swimming-stone, is found. It consists of right-lined laminæ, as thin as paper, which intersect one another in all directions, leaving, however, unequal cavities between them. In consequence of this cellular structure, the stone is so light that it swims in water.

Rare plants. Of rare plants, the following may be noticed as growing in Cornwall: near Fowey, on a slaty soil, to which it is extremely partial, *Sibthorpia Europæa*, which was discovered by Ray between 1670 and 1677. Near the village of Mullion, *Erica vagans*, the most rare and beautiful of the English heaths, grows in great abundance and luxuriance: it is also found near Helston. About the Lizard, *Asparagus officinalis*, and *Herniaria glabra* are found, but in no great abundance. *Tamarix gallica*, a shrub, for a long time not arranged among the British plants, grows wild in this part of Cornwall; some suppose that it is not indigenous to England, but was brought by the monks from Normandy to St Michael's Mount, and that it has spread thence over the west of Cornwall: it thrives rapidly in situations most exposed to the sea, and forms there an admirable shelter. On the borders of Mounts Bay, *Santolina maritima, Eryngium campestre, Panicum dactylon, Euphorbia Peplis, Euphorbia Paralias* are found. On the skirts of a wood, about a mile north from Bodmin, one of the rarest British plants has its *habitat*, viz. *Ligusticum Cornubiense*. *Laver* or *lichen marinus* is com-

Shells. mon on the shores of Cornwall; they also afford several uncommon species of shells; near Falmouth Dr Maton discovered *Tellina proficua*, and *Cardium exiguum*; and also a non descript species of *Venus*, which he named *Venus Cardioides*, from its resemblance to the *Cardia*. Treryn Cove, which is almost close to Castle Treryn, affords also several of the rarer species of shells: *Patella pellucida* is very abundant; and *Patella fissura, Mytilus modiolus, Trochus Cornutus*, and *Turbo Cimex*, are not uncommon on the rocks about the shore; near St Ives, *Helix maculosa*, one of the most elegant and rarest species of British shells, is found. In form and colour it approaches so nearly to the common snail of our downs, that it is very likely to be confounded with it, but the size will be found to be considerably larger.

Uncommon crow. The native cattle and sheep of Cornwall have been already noticed and described. There is also a species of crow, which, though not peculiar and confined to Cornwall, is so common on its coasts, that it is called the Cornish *chough* or daw: it frequents ruined towers by the sea side, and sequestered craggy rocks, especially on the part of the coast near St Michael. It is easily distinguished from the common crow by the redness of its legs and bill; and by its colour, which is a sort of violet black; it is remarkable for its propensity to steal and carry away whatever it finds, and it has been accidentally the cause of setting fire to houses by conveying lighted brands to the roofs; yet the natives are so much attached to it, that it is not uncommon to see tame ones in their gardens.

Fish. A great variety of fish are found on the coasts of this county, but none are so considerable an object of commerce, or afford employment and subsistence to so many people, as the pilchard. The pilchard fishery is carried on at St Ives, on the northern coast; in Mountsbay, on the southern; and thence eastward at St Mawes, Megavessey, and quite to the Devonshire coast. The pilchards make their appearance about the middle of July, and depart for the arctic regions about the end of September. The fishermen say, that fifty years ago, they did not leave the coasts of Cornwall till Christmas. The dog-fish haunts the coasts, and devouring the pilchard eagerly, is a great enemy to the fishery. Two kinds of nets are employed, a *stop seine*, which is generally 22 fathoms long, 16 fathoms deep in the middle, and 14 at each end: some of these seines will contain upwards of 200 hogsheads, each hogshead holding nearly 3000 fishes: the other kind of seine, is called a *tuck* seine, which is made similar to the *stop seine* but smaller, being generally only 108 fathoms long and 10 deep: three boats are necessary for each seine: the number of men employed varies from 17 to 24: they are paid partly in money, and partly by a share of the fish and oil. Sometimes a seine will take from 1000 to 1500 hogsheads in a season: the whole quantity may be averaged at about 50,000 hogsheads, of 40 gallons each, and 3000 fish in each cask. Some of the fishermen are stationed on the rocks to watch the course of the fish; these are called *huers*, from setting up a hue, when they observe a drove of pilchards. As soon as the fish come within the depth of the seine, the boat containing it is rowed round them, and at the same time, the net is thrown over; by this means they are completely surrounded; the fish are suffered to lie in the stop seine till low water, when they are taken out with the tuck-seine, and carried to the store-houses: if the quantity be very large, it sometimes requires several weeks to take them all out, as they must be salted immediately on their removal. The floor of the store-houses on which they are laid, is on a gentle declivity, that they may be kept dry and in good condition: in the store-houses, as well as in every cask, a quantity of salt is spread between every layer of fish; and in the packing, they are pressed very hard, with great weights, by the power of a strong lever. The oil is thus extracted: the pressing continues about 14 days, when the fish are fit for the merchant. Forty-eight hogsheads of pilchards usually yield a ton of oil: 420 lbs. of salt is necessary to cure a hogshead; and the usual quantity provided for each seine, is 3000 bushels. Men, women, and children, but principally women, are employed in the various processes of washing, salting, pressing, and making nets, ropes, &c.; the number is at least 5000. The capital engaged in the trade is supposed to be £300,000. The principal market before the war was Italy. Attempts have been made, since it was shut up, or contracted, to open a market in the metropolis, but they have not succeeded.

Manufactures. There are very few manufactures in Cornwall. Carew mentions, that in his time, the women and children in the west part of the county, made mats of a small and fine kind of bents, "which for their warmth and well-wearing are carried by sea to London and other parts of the realm, and serve to cover floors and walls." The principal places of trade are Padstow, Boscastle, and the river Hayle, on the north coast; Penzance, Falmouth, Truro, Fowey, and Looe, on the south. The exports are tin, copper, moor-stone, china-stone, fish, barley, oats, potatoes, and some wheat. The imports are goods and groceries from London, Bristol, and Manchester: considerable quantities of coals are also imported. A great number of cattle and pigs, and some sheep, are driven annually out of the county.

Antiquities. Cornwall abounds with antiquities of very ancient date, and generally supposed to be Druidical; of these the most remarkable, as well as the most common, are cairns, circles, cromlechs, and logan stones. The cairns are similar to those found in Scotland, and consist of a large heap of stones, piled up, generally on some mountain or eminence: *cromlech*, in the Cornish language, signifies a crooked stone. Near Castle Chun is a large one called the giants coit, which consists of four stones, the upper one, which is very large and heavy, resting on the other three, which are not placed erect, but inclined considerably. Dr Borlase is at a loss for the meaning of the word *logan*, but the word *log*, from which it is evidently derived, is very usually applied, both in Devonshire and Cornwall, to any thing moving to and fro. The most singular logan stone is near Castle Treryn: it is an immense mass of granite, probably more than 90 tons weight, poised in such a delicate and exact manner, on the top of one of the highest rocks, that a child might move it. The logan stones are generally supposed to be the works of art, or rather of human strength; but it is impossible to conceive how this one could be placed, where it is, by any human exertion. This consideration, and an attentive view of its structure, has induced Dr Berger to offer a much more plausible conjecture: in his Essay on the physical structure of Devonshire and Cornwall, he says, "I am satisfied that the logan stones formed at one time only one complete mass of granite, which, by the action of the atmosphere and other external agents, has split into irregular blocks; the greater part of these, though separated on all sides from each other, have remained in their original position, but now appear, as if they had been placed one above another." (*Transactions of the Geological Society*, p. 149.)

Views. There are some grand and impressive sea views in this county, particularly the view of St Michael's Mount, and of the Land's-end. The latter can scarcely be regarded without admiration, awe, and terror. There is a fine view of a very different character, afforded by the scenery round Loo-pool, about two miles from Helston: there is a picturesque richness and variety in this scenery not often afforded in Cornwall.

Pastimes. The people of Cornwall are celebrated for their fondness for athletic sports, in which they are very expert: the principal of these are wrestling and hunting. They are usually practised on holidays, particularly on the Monday and Tuesday after the Sunday which is kept annually in memory of the dedication of the parochial church. The tinners have holidays peculiar to themselves, particularly the Thursday before Christmas day, in commemoration of block tin being first melted into white; for formerly the tin ore was exported unmelted. The inhabitants of this county are in general of a large and strong make: this, joined to their skill in wrestling, has given rise to the proverbial expression, a *Cornish hug*. The miners are not long lived; few of them reaching beyond 55.

Parliamentary boroughs, &c. There are more parliamentary boroughs in this than in any other county in the kingdom; it returns to the House of Commons 44 members. This seems to have risen, in a great degree, from the large hereditary revenue yielded by the duchy to the crown, and is not of very ancient date. Cornwall is in the diocese of Exeter, and in the western circuit: it sends 640 men to the militia, and pays eight parts to the land tax. The assizes are held alternately at Bodmin and Launceston. Till about three centuries ago, a peculiar language was spoken in Cornwall, which was evidently Celtic, and allied to the Welsh and language of Bretagne. When Mr Barrington visited Cornwall in 1768, he found only one woman who could scold in it.

Ancient inhabitants. On the invasion of the Romans, this county was inhabited by the *Danmonii*, who a short time before that event had subdued the *Carnabii*, in the Cornish language Gwyr Cernyn, or the men of the promontory. The Romans included it in *Brittannia Prima*. When they withdrew from this island, Vortigern, earl of Cornwall, was chosen by the British chiefs as their head; but he, instead of trusting to their bravery, called in the Saxons. In consequence of the cruelties and oppressions of these new settlers, many people emigrated from Cornwall to the opposite coast of France, which thence took the name of Bretagne. Cornwall was not finally subdued by the Saxon kings of England till the year 938, in the reign of Athelstan; and some historians are even of opinion that he did not take possession of it, but merely obliged the inhabitants to confine themselves within the river Tamar. However this may be, William the Conqueror made Robert de Merton earl of Cornwall, with 793 warriors. His son taking part with Robert, duke of Normandy, was deprived of the earldom by Henry, who gave it to Reginald de Dunstanville. Henry II. took it on his death, into his own hands, and gave it to his youngest son John, who held it till he was king, at which time he granted it, first to Henry Fitzcount, and afterwards to his own son Richard, who was distinguished for his power and riches, and for his expeditions to the Holy Land. He was succeeded by his son Edward, on whose death, without issue, King Edward I. seized it, and gave it to his son, who, on mounting the throne, bestowed the title and honours on his favourite Gaveston. On the execution of Gaveston, Edward III. conferred it on his brother John de Eltham; and, on his death, the title was raised to a dukedom, and Edward, surnamed the Black Prince, was invested with it. Ever since that time the oldest son of the king is duke of Cornwall, sometimes by birth, and sometimes by patent. Of the immense hereditary revenues formerly belonging to Cornwall, only the income derived from the Duchy lands, and from the duty on the coinage of tin are unalienated.

The following statistical abstract is taken from the population return for 1811:—

Inhabited houses	37,971
Families occupying them	44,189
Houses building	441
——— uninhabited	1,400
Families employed in agriculture	17,465
——— in trade, manufactures, &c.	10,954
——— not included in these classes	15,770
Males	103,310

Corona, Coroner,

Females 113,357
Total 216,667
Population in 1801 188,117

Increase since 1801 28,550

See Worgan's *Agriculture of Cornwall;* Maton's *Observations on the Western Counties; Magna Brittania,* vol. i.; *Beauties of England and Wales,* vol. ii.; *England Illustrated,* vol. i.; Carew's *Survey of Cornwall;* and *Transactions of the Geological Society.* (w. s.)

CORONA. See OPTICS.

CORONER (*coronator,* from *corona,* the crown) is the name given to a very ancient officer of the realm at the common law of England, of whom mention is made so early as king Athelstan's charter to Beverley, in the year 925. He is called coroner, because he has principally to do with pleas of the crown, or such as more immediately concern the king. According to this view, the Lord Chief Justice of the King's Bench is the sovereign coroner of the whole kingdom, and may, if he pleases, exercise the jurisdiction of that officer in any part of the realm. But there are also special coroners for every county in England, who are, along with the sheriffs, conservators of the peace in the counties where they are elected; and it is to these particular coroners that the following observations apply.

The coroner is chosen by all the freeholders assembled in the county court; for which purpose, there is a writ at common law *de coronatore eligendo,* in which the sheriff is expressly commanded, *"quod talem eligi faciat, qui melius et sciat, et velit, et possit, officio illi intendere."* By the statute of Westminster, i. c. 10, this officer ought to be a sufficient person, that is, the wisest and discreetest knight that best would and might attend upon such an office; there is also a writ in the register, *Nisi sit miles,* &c. from which it would appear that a coroner must be a knight, and have, at least, an hundred shillings rent of freehold; and there is an instance in the 5 Edward III. of a man being removed from this office because he was only a merchant. But at present it seems to be sufficient, if a man possess lands enough to be made a knight, whether he be really knighted or not; for the coroner ought to have estate sufficient to maintain the dignity of his office, and to answer any fines that may be imposed upon him for his misbehaviour; and if he has not enough to answer, the fine shall be levied on the county, as a punishment for electing an insufficient officer. The office of coroner, however, has now been suffered to fall into disrepute; and instead of being filled by gentlemen of property, who neither required nor would condescend to receive payment for serving their country, and who, indeed, were expressly forbidden by the above mentioned statute of Westm. i. to take any reward, under the pain of great forfeiture to the king, it has for many years past been conferred upon inferior persons, in indigent circumstances, who have offered themselves, with a view to the emoluments of the office, being allowed certain fees for their attendance, by the statute 3 Hen. VII. c. i. The coroner's office is for life; but he may be removed, in obtaining any other situation incompatible with its duties; or by the king's writ *de coronatore exonerando,* wherein the cause of incapacity must be assigned.

The duties of a coroner are either ministerial or judicial, but principally of the latter description; and they are, in a great measure, ascertained by the statute 4 Edw. I. *de officio coronatoris.* He is to enquire into the manner of death, when any person is slain, or dies suddenly, or in prison. This enquiry must be made *super visum corporis,* at the very place where the death happened, in presence of a jury of four, five, or six of the inhabitants of the neighbouring towns. If any person be found guilty of murder by this inquest, the coroner is to commit him to prison for further trial; and to enquire also concerning his lands, goods, and chattels, which are forfeited thereby, &c. This is called the *coroner's inquest,* or *inquisition,* which must be certified to the court of King's Bench, or to the next assizes. It is also the duty of the coroner to enquire concerning shipwrecks and treasure-trove.

Coronilla, Corporation.

The coroner, in his ministerial capacity, acts only as the sheriff's substitute, when any just exception can be taken to the sheriff. See Blackstone's *Comment.* b. i. ch. 9; and Jacob's *Law Dict.* (z)

CORONILLA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 282.

CORPORATION, is a body politic, or artificial person, of capacity to grant and receive, to sue and be sued, maintaining a perpetual succession, and enjoying a kind of legal immortality.

A corporation may be either *sole* or *aggregate.* It is *sole,* when the corporate rights are vested in a single individual; and *aggregate,* when they are vested in a number.

Corporations, of which there are various species, have been instituted for the advancement of religion, of learning, and of commerce, with the view of preserving for ever entire those rights and privileges, which, if vested only in the persons of individuals, would, like all other personal rights upon their death, be utterly lost and extinct. These political bodies would appear to have been originally invented by the Romans, and, according to Plutarch, were first introduced by Numa Pompilius, who instituted separate societies of every mechanical trade and profession. They were recognised, and much considered by the civil law, under the name of *universitates* or *collegia;* and adopted by the canon law, for the purpose of maintaining ecclesiastical discipline. The Romans, however, had no notion of *sole* corporations; with them the number of three was requisite; although a corporation, originally consisting of three persons, might still subsist when reduced to a single number.

Corporations, whether sole or aggregate, may be divided into *ecclesiastical* and *lay.* The former consist entirely of spiritual persons, and are erected with the view of promoting religion, and perpetuating the rights of the church. *Lay* corporations are either *civil* or *eleemosynary.* Civil corporations are erected for different temporal purposes, for the good of government, for the advancement and regulation of commerce and manufactures, &c. Eleemosynary corporations are constituted for the perpetual distribution of the free alms or bounty of their founder; such as hospitals, &c. By the civil law, it does not appear that any authority was required to create a corporation beyond the mere voluntary act and association of the members, provided it was not established for purposes contrary to the existing laws. But in England, the consent of the king is absolutely necessary to the establishment of a corporation, and this consent may be either express or implied. The royal consent is implied in those corporations which exist by force of the common law, to which former kings are presumed to have given their concurrence, and in all those which exist by prescription. The king's consent may be given expressly, either by act of parliament, or by charter. The creation may be made by the words "*creamus, erigimus, fundamus, incorporamus*," or the like. And the law even holds, that it is sufficient to create a corporation, if the king grants to a set of men to have *gildam mercatorium*, i. e. a mercantile meeting or assembly. The king, it is thought, may also grant to a subject the power of erecting corporations, upon the principle, *qui facit per alium, facit per se*. Such are the matriculated companies, erected by the chancellor of the university of Oxford, of tradesmen subservient to the students. Every corporation must have a peculiar name, by which alone it sues, and is sued, and performs all legal acts.

The powers, rights, and capacities, which are incident to all corporations, may be classed under the five following heads. 1. To have perpetual succession. 2. To sue and be sued, grant and receive, &c. by their corporate name. 3. To purchase lands, and hold them for the benefit of themselves and their successors. 4. To have a common seal. 5. To make bye-laws, or private statutes, for the better government of the corporation, which, however, must not contain any thing contrary to the law of the land, otherwise they are void. There are also certain privileges and disabilities incident to an aggregate corporation, which are not applicable to such as are sole. It must always appear by attorney. It cannot be made a party to an action of battery, or such like personal injuries. It cannot commit treason, or felony, or any other crime; nor is it liable to corporal penalties, nor to attainder, forfeiture, or corruption of blood. It cannot be executor or administrator, or perform any personal duties, or be seised of lands for the use of another. Neither can it be imprisoned, or outlawed, or excommunicated. An aggregate corporation may take goods and chattels for the benefit of themselves and their successors; but a sole corporation cannot. Aggregate corporations having, by their constitution, a head, cannot do any act during the vacancy of the head-ship, excepting that of appointing another; nor are they, while in that situation, capable of receiving a grant. But there may be an aggregate corporation constituted without a head. In aggregate corporations, the act of the majority is esteemed the act of the whole.

In order that corporations may not deviate from the end or object of their institution, the law provides proper persons to visit them. In the case of ecclesiastical corporations, the ordinary is constituted visitor by the canon law. In former times, the pope, and now the king as supreme ordinary, is the visitor of the archbishop or metropolitan; the archbishop of all his suffragan bishops; and the bishops of all the spiritual corporations in their respective dioceses. In regard to lay corporations, the founder, his heirs or assignees, are the visitors. In general, the king being held to be the sole founder of civil corporations, and the endower the perficient founder of all eleemosynary ones, the right of visiting the former is in the crown, and of the latter in the patron or endower. The crown's right of visitation is exercised in the court of King's Bench. If the founder of an ecclesiastical corporation appoints no visitor, the bishop of the diocese must visit.

A corporation may be dissolved; 1. By act of parliament. 2. By the natural death of all its members, in the case of an aggregate corporation. 3. By the surrender of its franchises into the hands of the king. 4. By the forfeiture of its charter. See Blackstone's *Comment.* b. i. ch. 18.

Corporations erected for the benefit of particular branches of trade and manufactures, to which the commercial policy of modern times has been extremely favourable, have been condemned, by the most eminent political economists, as injurious to the interests of the community. These injurious effects result, 1. From the obstruction of the free use and circulation of labour; 2. From the limitation of competition; and, 3. From the facility afforded to combinations among tradesmen, for the purpose of defrauding the public. The reader will find this subject amply discussed in Dr Smith's *Wealth of Nations*, passim. (z)

CORPUSCULAR PHILOSOPHY. See MECHANICS.

CORREA, a genus of plants of the class Octandria, and order Monogynia. See BOTANY.

CORREGGIO. Of the history of this very eminent painter, little is known with any degree of certainty. Even the exact time and place of his birth are points on which his biographers are not agreed, though it seems the opinion most generally received, that he was born in the year 1494, at Correggio, a small town in the duchy of Modena. With regard to his parentage and education, it is asserted by Vasari on the one hand, that he was the son of a labourer, who was unable to afford him the advantages of early instruction; while, on the other, Sandrart and Orlandi contend, that he was of a noble family, that he received a liberal education, and that he lived and died rich. It has, with great justice, been observed by Raphael Mengs, who was at infinite pains in collecting every thing that is known or conjectured of the history of Correggio, that the elegance and dignity of sentiment which appear in his works, strongly corroborate the supposition, that he possessed that general cultivation of mind which natural talents could scarcely have produced without the benefit of a good education. He is said to have received instructions in painting from Francesco Bianchi, surnamed Il Frari; and afterwards from Andrew Mantegna. But however that may be, he must be considered as little indebted to them for those peculiar excellencies which distinguish his works, in which grace, grandeur, and angelic beauty, appear in all the charms of the most delicate and harmonious colouring, and with all the magical illusions of the chiaro-oscuro, carried to the highest possible pitch of perfection.

The most important work of Correggio is the cupola of the cathedral at Parma, which he finished in 1530. This has always been considered as one of the most wonderful productions of the art. Its form is octangular, and the subject with which it is decorated is the Assumption of the Virgin, executed in fresco. In the upper part of the composition, he has represented the Virgin Mary, surrounded by an immense assemblage of angels, some throwing incense, and others triumphantly applauding. Every one must be struck with the angelic expression which he has given to them. The smoke of the tapers, which are constantly burning in the church, has considerably affected the colour of this work; but notwithstanding the dusky hue it has assumed, joined to all the disadvantages of a very unfavourable light, it continues to excite the surprise and admiration of every judicious beholder. Another great work of Correggio, and the first in point of time which he painted at Parma, is the cupola of the church of St John of the Benedictine Fathers. In the middle is the figure of Christ, suspended in air, with the twelve Apostles below, seated on clouds. These figures, which are naked, are generally allowed to combine, in a remarkable degree, greatness and beauty of form. They were much studied by the Carraccis, and considered by them as models for their imitation. It has been doubted whether Correggio ever visited Rome; but whoever considers the style of design in this composition, will be induced to believe that he had seen and studied the works of Michael Angelo. In the lunettes he has represented the four Evangelists, with the four Doctors of the Church. These figures, again, are remarkable for their resemblance to the style of Raphael. This resemblance is still more apparent in the St John, painted on the door of the vestry of the same church; from all which it is argued, that Correggio did not, as some have supposed, confine himself to the casual sources of improvement which existed in his native province, but that he had carefully availed himself of whatever he could derive from an attentive study of the works of his great predecessors. Following the account given by Vasari, it has been usual, with the subsequent biographers of the painters, to expatiate on the obscurity in which Correggio lived and died—the low prices paid for his labours—the timidity, diffidence, and melancholy of his disposition; and they close their sad account by informing us, that he lost his life in a fever, which was occasioned by bearing home on his shoulders sixty crowns in copper money, which he had received as payment for one of his works. What proportion of truth there may be in this statement, it is quite impossible to decide. The story of his death is generally believed to be true. But if we consider the cheerful gaiety of many of the characters he introduced into his compositions—the importance and extent of the works which he undertook and executed—and the remarkably excellent and costly materials which he often employed,—it is not certainly the conclusion to which we should be very naturally conducted, either that the habits of his mind had been characterised by melancholy and diffidence, or that obscurity and indigence were among the list of evils with which he had to struggle. But these facts, be they as they may, are of little importance to be accurately known. The various and contradictory theories which have been proposed, and the solicitude with which their respective authors have endeavoured to give them the appearance of probability, are perhaps worthy of any notice only in as far as they tend to shew the interest with which the subject of them has been regarded, and as exemplifying the natural and laudable propensity of the human mind, to attach importance even to the accidental and accompanying circumstances which have attended great talents in their progress to excellence and celebrity.

At the time that Correggio appeared, the art of painting had, by slow and progressive steps, arrived to great perfection. But, notwithstanding that dignity and grandeur of form which had been invented by the superhuman powers of Michael Angelo—although splendor and truth of colouring were conspicuously exemplified in the works of Titian, while expression and grace appeared in those of Raphael,—it still remained to combine, in an eminent degree, these different excellencies in one style. It seems admitted, by competent judges, that in the best works of Correggio, this happy union has been effected in a more remarkable degree than is to be found in those of any other painter. Even those, however, who are most zealous in his praise, do not pretend to deny that his drawing is, in general, inaccurate; although several of his works demonstrate that he fully understood this branch of his art, and that he could practise it when he chose. It does seem strange, that, with the power of sometimes being excellent in what is so justly considered of primary importance, he could allow himself to degenerate into habitual incorrectness of design. With regard to the style of Correggio, and particularly to this unaccountable paradox in his practice, we may quote the words of the late Mr Barry in one of his letters to Mr Burke. "I shall say nothing of Correggio's ceilings in the Duomo and in St Giovanni at Parma; they are, I will allow, what might be expected from the great abilities of such a man. But as I do not like this kind of painting where macchia and effect is more consulted than expression, beauty, form, and character, so I shall leave for others to say about it what they please. Correggio's fragment of the Annunciation is excellent, full of grace and beauty. His Madona della Scudella is admirably well coloured in all the parts, but the drawing is bad, and much wanting in the proportion, &c. This picture is a convincing testimony that he was ignorant of drawing (very ignorant), and yet some part of his other picture of S. Girolamo, at the Academy, proves as convincingly that he drew well, and very well, and in excellent, proper, and variegated proportions. To reconcile this might be more difficult and troublesome than useful, and therefore I will only suppose either that this Madona della Scudella was an early work of Correggio's, or that sometimes he made light of the drawing of his figures, or that sometimes he succeeded in his drawing more from pains and a habit of mere imitation, than from principles and knowledge. There are other pictures by him in S. Giovanni, in which there is much to praise and something to dispraise. In the Palace of S. Vitale is a little Madona and Child by him, which is very excellent, and much like Titian's manner of colouring, which is very different from the general style of Correggio."

With regard to this last remark, it must be observed, that the colouring of Titian is only to a *certain degree* compatible with the peculiar excellencies which characterise the style of Correggio. It was one of the great objects which this painter had in view, to give throughout the whole of his works a certain delicacy and softness in the outlines, so that in many instances his figures seem as it were blended with the grounds on which they are painted. To this is owing one of the most characteristic circumstances in his style; for almost to this alone is to be ascribed that extreme delicacy and tenderness of effect, which we look for in vain in the works of the Roman or Venetian schools. Now, it is a fact well known to the professors of the art, that in proportion as the contour is made soft and blending, in the same proportion it becomes necessary to discharge all decided and positive colour from the picture; and, on the other hand, whenever such decided and positive colours are introduced, it is absolutely necessary to support these by a corresponding strength and hardness of outline. There is therefore a natural limit to the compatibility of the peculiar qualities which, in this respect, Correggio had it in his view to combine, and of that limit he seems to have been thoroughly aware. The law of art by which he was guided in this respect is plainly founded in nature. The degree of light, which shews strongly and sharply the outlines of objects, (in every instance, excepting in the case of their being seen opposed to a light,) must at the same time serve to show their local colours in a corresponding degree of distinctness; and, on the other hand, if we diminish the light which falls on objects, till at last we lose sight of all sharpness of outline, we must, in the same degree, lose sight of all distinct local colour; so that if we set out with the principle of introducing bright colours, we must of necessity give up that tenderness of outline which Correggio esteemed so great a beauty; or if we adopt his tender outline, variety of colour, in a great measure, must be avoided, as inconsistent and unnatural. In this country, there are few genuine works of Correggio to which we can refer as examples, to illustrate how far this general rule guided his practice. We may, however, mention the beautiful specimen in the possession of Mr Angerstein, which represents our Saviour praying in the garden, and an angel listening, while the disciples are seen at some distance sunk in sleep. The utmost degree of tenderness and delicacy as to outline, and the greatest sobriety and softness of effect, are remarkable throughout the whole of this highly beautiful composition. A solemn twilight is spread over all the parts of it; and as there is scarcely a single sharply marked line, so there is scarcely any distinguishable variety of colour, and the whole is reduced nearly to the simplicity of mere chiaro-scuro. There is also a picture by Correggio, but somewhat different in the general management and effect, in the possession of Mr Otley of London, in which the artist has represented the story of Jupiter and Io. A greater degree of illumination is admitted into this composition; and, in conformity to the law we have stated above, the contours are more firm and decided, and a greater strength and variety of tint is introduced. Chiaro-scuro is so inseparable from design, that the one cannot perfectly exist without the other; because design without light and shadow can only represent a section of an object, and can therefore never express the form of its surface. Correggio is eminent for the knowledge and skill with which he models, as it were, the surfaces of the objects he represents, so that one may see in his pictures where the surface rises, or where it sinks, even though his outline were hid, and that with the same appearance of reality, as if we were looking at the natural objects themselves. For his excellence in this respect, he is said to have been indebted to his study of sculpture and modelling under Antonio Begarelli, of whom Michael Angelo speaks in high terms of praise.

Of his oil paintings, one of the most celebrated is the picture called the St Jerome of Correggio. In this picture he has represented the Virgin Mary seated, with the infant Jesus on her knee; Mary Magdalene, in a kneeling attitude, embraces the foot of the Saviour, whilst St Jerome presents a scroll to an angel. The two altar pieces, which he executed for the church of St Giovanni, are also much esteemed; one representing the martyrdom of St Placido, and the other the descent from the cross. These inestimable pictures have been torn from their situations by the French, and are now deposited in the Museum of the Louvre. It is worthy of notice, that the French artists then resident at Rome, in a memorial highly creditable to themselves, stated to the National Convention the injury which the cultivation of art would receive from removing those *chefs-d'œuvre* and others from the situation for which they were originally painted. But this amiable appeal met with the reception which might have been expected from such a tribunal.

In the gallery at Dresden is his famous work, called the Notte, representing the Nativity, and an exquisite picture of the Magdalen reading. There are two pictures that have also been much celebrated, which originally were presented by the Duke of Mantua to Charles V. and which afterwards were in the collection of the Duke of Orleans. One represents Leda and the other Danae. In both compositions the fables to which they allude are told with all the delicacy that is consistent with their being intelligible. A story which is given by Azara of these two pictures is worth mentioning, as a curious instance of that capricious fate which sometimes attends the noblest works of art. They had been sent by the Emperor Charles V. to Prague, where they were placed in the royal palace, and where they remained till the famous thirty years war, when that city being sacked by the Swedes, Gustavus Adolphus sent them to Stockholm. That king being dead, they remained unknown in the minority of Queen Christina, until an ambassador, who knew the history, sought after these paintings, and at last found them out serving as shutters for the windows of a stable. "They were repaired," he adds, "and that queen esteemed them as they merited; she carried them herself to Rome as precious things, and obtained previous license of the Pope to take them out of the Popedom whenever she wished."

We must not omit mentioning the celebrated anecdote of Correggio, which is told by those of his biographers, who admit the fact of his having ever visited Rome. It is said that, on beholding the frescoes of Raphael in the Vatican, he gazed in silence for a long time on these divine works, and that at last, conscious of his own transcendent but less regarded talents, he broke forth in the expressions of a manly and just self-confidence, "*Ed io anche son pittore.*"

On the whole, when we consider the perfection to which this illustrious person carried his art, the sweetness and delicacy of his execution, the unrivalled harmony of general effect which appears in all his works, the truth and illusion of his light and shade, and the perfect knowledge he displays in all the mechanical parts of his art; but above all, when we consider the dignity of his conceptions, and that character of celestial purity and beauty which he has imparted to many of the more exalted personages in his compositions; while, on the one hand, such a combination of excellencies must place Correggio in the highest rank as a painter, the very nature of those excellencies, when thus carried to such a degree of perfection, seems, on the other, absolutely irreconcileable with the commonly received opinion, that through all the disabilities of ignorance, indigence, and obscurity, he sought out his way to these without a guide, and that he never even saw the works of his great contemporaries and predecessors. That such an opinion, without the very best evidence to support it, should ever have gained currency, seems strange; an opinion inconsistent with all that we know of the natural progress of the art itself, at variance with the fixed laws which regulate and limit the progress and power of the human faculties, and contradicted by the direct testimony which even the works of his early years contain. When we consider, also, the moderate distance between his native province and the great depositories of the arts in Rome and Florence, it seems inconceivable that he should not have visited these, unless we can suppose that, among the other marvellous circumstances in the structure of his mind, it was deprived of the principle of ordinary curiosity.

He died in 1534, in the prime of life. The family name of Correggio was Alegri. He sometimes signed himself Antonio Lieto da Coreggio. (*t*)

CORRIGIOLA, a genus of plants of the class Pentandria, and order Trigynia. See BOTANY, p. 168.

CORSICA.

Corsica. Boundaries.

Corsica, (*the Island of,*) is situated in the Mediterranean Sea, between the 41st and 43d degrees of N. latitude, and the 8th and 10th degrees of E. longitude. It is bounded on the north by the Ligurian Sea and the Gulf of Genoa; on the east by the Etruscan Sea; on the south by a strait of about 10 miles in breadth, which separates it from Sardinia; and on the west by the Mediterranean. It is about 40 leagues distant from the coast of Antibes. It is nearly at the same distance from the coast of Genoa. It is 20 leagues distant from Tuscany, and about four from Sardinia. Its greatest length from the most northern part, which is Cape Corso, to the southernmost near Bonifacio, is about from 38 to 39 French leagues. Its breadth, which is unequal, is in some places 18 leagues, in others it is 15, and in some it is yet much less. Its coasts are indented by several gulfs and creeks, which renders it difficult to ascertain its precise extent. It cannot, however, be less than 120 leagues round, and its superficial measurement may be estimated at 527 square leagues. A chain of mountains traverses the island in form nearly of a cross, beginning at Bastia, and thence to its most southern point dividing it into two parts, the east and west, which are distinguished by the inhabitants as the parts on this side and on that side of the mountain. Fertile vallies extend on all sides around the mountains in the interior, reaching even to the sea-coast, and agreeably diversified by rising grounds, which, as well as the mountains themselves, or at least the lower of them, are also considerably productive. The loftier of the mountains are for the most part of the year covered with snow.*

Climate.

The climate of Corsica is mild, the cold which proceeds from the mountains being tempered by the sea-breezes, and on the other hand, the wind which blows over them rendering the summer's heat less oppressive. Violent storms are not uncommon in the winter months. The air, however, is for the most part clear and salubrious, except in places in the vicinity of stagnating waters and marshes, which are here numerous, and the inhabitants live to a very great age.

Agriculture.

Corsica produces wheat, rye, barley, millet, but no oats. The horses and mules are fed with barley. The returns obtained here by the cultivator are very great, extending to 60, 80, or even to 100 or more, for one. This abundant increase is by no means the consequence of superior skill or industry on the part of the occupier. On the contrary, agriculture is here in a very imperfect state. The implements of husbandry are bad, and the Corsicans do not make the best use even of those which they have. Their labour does no more than scratch the surface of the earth; and the advantages to be derived from manures, which might be had in great plenty, are almost altogether unknown. There may be some exceptions to these remarks, and abundant harvests, it may be expected, will be found chiefly in those parts where there is the most of industry and of attention to the means of improvement. But the great source of those plentiful returns, is the prodigious natural fertility of the soil, which is manifested, as in other respects, so most happily and usefully by the great strength of the stalks that distinguish the grain of this country, and to which it is owing that the weight of the ears never causes any lodging of the crop. There are two circumstances connected with the state of this island, to which, perhaps, chiefly may be attributed the neglect of its agriculture. These are the figure of the island, and the political state of the country. From the vicinity of the most improvable parts of this island to the sea, and the consequent fear of pirates, it became less an object to bestow a careful cultivation, when the chances were so great that the same hands which sowed should not be permitted in quietness to reap the harvest. The imperfect state of internal regulations within the island itself, would naturally contribute to the effect thus produced by the fear of danger from without. It is impossible to estimate the new degrees of activity in cultivation, and of consequent benefit to those engaged in it, that might be the result of the settlement of this country in a state of greater security, and of adequate encouragements being held out to an improved agriculture. Even a farther extension of leases, which for most part have been limited here to one year, would lead to many meliorations, and to the substitution of a good method of culture, in the place of the abusive practices which ruined the land. These advantages have, in consequence of the improvements in those respects that have been already introduced, been experienced in some degree, and their farther extension would no doubt follow in a just proportion upon a more enlarged operation of the same causes.

Forests.

At the time that Corsica, in the year 1766, came into the possession of France, it was ascertained that 160 square leagues of its surface were occupied by forests. The most considerable of them is that of Vico. Among the resinous trees found in these forests, the pine and the larch are distinguished by their beautiful veining and the excellence of the timber. This is the case particularly as to the larch, which has the appearance of being a beautiful variety of the larch of the Alps, or of the cedar of Lebanon. Both those kinds of trees, in respect as well of the quality of the wood as of its dimensions, may serve for the parts above water of vessels of the largest size, and are indeed, for that purpose, superior to any thing that can be obtained from the north of Europe. It is to be observed, that the timber of Corsica generally is much harder than might be expected in so southern a latitude, owing perhaps to the rockiness of the soil of the country, to the perpetual currents of fresh air that are passing through the vallies, and to the cool temperature proceeding from the mountains.

Wines.

Several cantons of the island of Corsica produce excellent wines. At Cape Corso there are two sorts of white wine made, one of which has so much resemblance to Malaga, that a great quantity of it is every year exported to Germany, and is sold as the genuine wine of that name. Part of it is also sent to Leghorn for the English market, where in like manner it passes for the true

* The loftiest of the mountains of Corsica, is that called by the ancients Mons Aureus, and now Gradaccio, or Monte Rotondo. It is of a very great height, and commands a most extensive view of the whole of the island, together with Sardinia. There is also from it a distant prospect of Italy and France, and even of the Mediterranean, with many of its little isles. This mountain is of very difficult access, the upper part of it being almost a perpendicular rock.

Corsica.

Spanish wine. The other kind of white wine that is prepared at Cape Corso, most nearly resembles the French Muscat wine called Frontignac. At Furiani, there is prepared a white wine, which might pass for Syracuse, only that it is not quite so sweet, though it is perhaps superior to it. In some of the villages, there is a white wine made, of an agreeable sweetness, and which has the flavour of Tockay. At Vescovato and at Campoloro, a wine is produced, which has some resemblance to Burgundy. Throughout the whole island, indeed, there are found wines differing in their tastes, insomuch that it may seem surprising how within such narrow limits, as to the differences of soil and exposure, while often the level of the ground is the very same, there can be produced such considerable diversities. In general it may be observed, that the juice obtained from the grapes of Corsica is so generous, that though even unskilfully prepared, it always pleases, from the agreeableness of the natural flavour.

Raisins. Besides the wines, there is also obtained annually at Corsica an abundance of fruit for the preparation of raisins.

Trees, &c. The olive tree thrives in every part of Corsica. It appears, indeed, not to have been very early introduced into the island, as it is said that the Corsicans are indebted for its introduction to the father of the present emperor of France. It now constitutes a principal source of the riches of the country. The olive tree grows here to a greater height and thickness than it does in the southern departments of France. It succeeds better in cold than in warm years, and the oil obtained from it, though not prepared with due care, is yet considered to be of good quality. The lemon, the pomegranate, the orange, the almond, and the mulberry trees succeed also well in this island. Chesnut trees are very abundant and productive, and the fruit, which can be collected with very little trouble, serves as food both for horses and men. It is perhaps in one view a disadvantage, that a subsistence may here be so easily obtained, as the effect is to render the people indolent, and to throw an additional obstacle in the way of improved cultivation. Aloes flower here as well as in the east; and the Indian fig is also one of the productions. Several of the trees of this island attain to great dimensions, the oak and other inhabitants of the forest, not less than the fruit trees. Indeed a sufficiency of timber might be found here for the establishment and maintenance of a large fleet; and if it could be easily transported, a very great return of revenue might be obtained for the country from the sale of this description of its produce. A great deal of flax is raised in this island; but though considerable attention is paid to the culture of the mulberry trees, the quantity of silk that has been procured has never been of much importance.

Animals. The island of Corsica produces all kinds of wild and tame animals. Most commonly, however, they are of a smaller size than those of the continent. The same is the case even with the men of the island, whose stature does not usually exceed five feet. The horses of Corsica are of the Sardinian breed. Like the mules and asses, though small, they are active and strong. The horned cattle are in proportion of a larger size than the horses, but they are inferior in quality. Indeed there is a want of proper pasture in the island, so that generally the cows give but little milk, and the oxen are lean and cadaverous. Grazing generally is much neglected, and the produce of the dairy is in little request. Oil, as in Italy, and in almost all hot countries, supplies the place of butter, of which therefore but little is made. Some of the cantons, however, furnish cheese of good quality. There are here numerous flocks of sheep, which having excellent pasture on the mountains, the mutton is very delicate, and yields a very rich juice. This is in some measure a compensation for the badness of the beef of the country. The sheep of Corsica are in general black or tawny, a white sheep being as rare among the flocks of this island as a black one is amongst ours. The wool is coarse and rough in the pile, which is attributed by the inhabitants of the country to the sheep being of a mongrel breed. Attempts have been made to correct this defect by the introduction of better breeds from England and from Spain; but the graziers assert that the inferior quality of the wool is less the consequence of any thing in the breed than of the nature of the pasture. In proof of this it is mentioned, that sheep which yield but a coarse wool in one farm, will, if removed to another in which the pasture is better, give a superior fleece. It is not unusual in Corsica to see sheep with more than two horns: some have as many as six. The muffoli is a kind of wild ram, covered with hair instead of wool. It lives on the highest mountains, where it can hardly be approached; but when taken young, it is very easily tamed. There are here vast numbers of goats which browse upon the wild hills, and the forests abound in deer. The swine of Corsica, which are very numerous, having all a mixture of the wild boar, and being fed on chesnuts, form a very agreeable food. The wild boar is found on the island in great plenty. The Corsicans are very fond of the diversion of hunting this animal, for which purpose they have a race of dogs particularly well adapted to it. These have a smooth hair, and are something between a mastiff and a strong shepherd's dog, large and exceedingly fierce, but very faithful where they have once formed an attachment. Bees abound in this island. Indeed it has been noted for its swarms of those useful insects, and for its copious supply of their productions from the earliest times. Both the low grounds and the hills are plentifully stored with the plants which furnish those creatures with their most grateful food. The honey, however, of the island has generally been accounted somewhat bitter, owing to the access which the bees have to the boxwood and the yew. This bitterness is by many considered not disagreeable. The best of the Corsican honey is said to be that which is obtained from Caccia. The wax is noted for its goodness and firmness. There is abundance of hares in this country. Foxes are also numerous, and they are here extremely large and ravenous. But there are no wolves nor rabbits, and very few venomous animals.

Birds. Of birds, those which principally occur in Corsica are the eagle, the vulture, the wood-pigeon, turtle, thrush, blackbird, and many of the smaller species. There is likewise plenty of game, as partridges, woodcocks, snipes, and water fowl in the lakes.

Fish, &c. The sea coasts of this island, as well as the lakes and rivers, of which it has several, abound with fish. These are in the greatest variety, and of the best kinds. There are particularly noted a kind of thunny or sturgeon, the sardinas a fish of an exquisite flavour, and oysters. The oysters are found on different parts of the shore in beds, and are of a remarkable size. They are in such quantity, that, besides the consumption of the country, great numbers of them are exported to Italy. Beautiful coral is obtained upon the coast opposite to Sardinia: it is of all the three kinds, white, red, and black. There are several marshes towards the shore, some of which being filled with sea water, yield salt sufficient for the consumption of the island.

Lakes.

The principal lakes of Corsica are the Ino and the Crena, which are situated in the interior of the island, at the distance from each other of about two miles, but they have both their origin in the same mountain, viz. the Gradaccio. They are both of considerable extent.

Rivers.

The chief of the rivers is the Golo, which, taking its rise from the lake Ino, traverses several provinces, and runs a course of upwards of 70 miles before it falls into the sea. The Tavignano, rising from the lake Crena, has also a long course through a very rude tract of country. The Restonica is a small river, but is noted on account of the clearness and the agreeableness of its water, and for its quality of whitening every thing over which it passes. There are several other rivers of less consideration, and likewise many rivulets, which serve at once to enrich and to beautify the country. The fish which chiefly occur in those fresh waters are the trout and the eel: these are found in great plenty, very fat, and of an uncommon size. There are many mineral springs both of the hot and cold kind, in different parts of the island, which the inhabitants of the country consider to be very efficacious for the cure of various distempers.

Mineral productions.

Corsica is very rich in mineral productions. The mountains yield lead, copper, iron, silver, antimony, alum, granite, porphyry, and jasper. Fine serpentine stone, talc, asbestos, and saltpetre, also rock crystals, are likewise procured here. Some of the silver mines are very rich, and the iron is said to be of a superior quality, not yielding in hardness to the prepared iron of Spain, which is the best in the world.

M. Rampasse, who had been some time an officer in the Corsican light infantry, gives an account of a stratum of a particular iron ore which he found in this island. It occurred in a plain above the village of Calenzana, to the eastward of Galoria. It is placed horizontally in a yellow earth, which at times disappears throughout the whole length of the ore, and the mineral of which is presented in three different views. First, it appears under the character of scaly iron, arranged in thin layers, mixed with a yellowish ochrey earth; afterwards it assumes the aspect of a heavy blackish iron, compact, and almost entirely disengaged from every heterogeneous substance; and, lastly, it presents itself in elongated spheroids, from four to five inches in diameter, exfoliating at the surface, and compressed at the two sides, and at intervals consequently assuming an angular appearance. In consequence of the sandy character and composition of this ore, M. Rampasse denominated it *arenaceous iron;* and having procured specimens of it sufficient for making the necessary experiments, he ascertained that it was a very productive ore. The quality of this iron will probably be made known by the result of the assays of the council of mines, to which portions of the ore were, with a view to the farther trial of it, transmitted by the discoverer.

The same gentleman was at considerable pains in endeavouring to find specimens of the so much celebrated orbicular granite of this island. Having arrived at the village of Olmetto, on the gulf of Valinco, which had been pointed out to him as the place containing this granite, he examined minutely every corner in the vicinity. He sounded the small lake in the neighbourhood; he visited the sea-shore; he explored by every means the river Taravo, which flows in this quarter, and endeavoured to ascertain the composition of the granites lying upon the heights surrounding the great valley through which this river passes. Having then made a comparative examination of the various specimens of rocks which he had seen in the course of this investigation with the orbicular granite, he found that though in some of these specimens there were hornblend and feldspar, yet they were not disposed in the same order as in the orbicular granite, nor in the same arrangement. He conceives, however, that from the appearance which these present, there is some prospect that the primordial masses of this magnificent granite may yet be discovered. He is at least confident, that the small mass of it already known could have come from no other place: it was found isolated upon the beach of Taravo, half a league from the sea, in the gulf of Valinco; the angles of it were rounded.

Minerals.

M. Rampasse farther takes notice of a new rock, which he considers as an appendage of this beautiful granite of Corsica, and which he discovered in the Nicolo, one of the most considerable mountains of the island. Here he says he found a block of stone almost square, and about 4½ feet long. It was sunk into the ground, and exhibited on one of its sides globular bodies, remarkable from their disposition and colour, and which were fixed in the stony mass. Some of them were about an inch in diameter; others were larger or smaller, but all of them presented a peculiar character, which this writer had never seen in any stone. Not more than six inches of the rock appeared above ground, but the earth surrounding it having been removed, it was found to be two feet and some inches in thickness. Its angles also were observed to be entire and acute, from which it seemed probable that it had never been removed since it had been placed there. This was the more probable, as the part of the slope of the mountains where it was found was bare, and as among the various blocks and masses surrounding it, it was the only one covered with vegetable earth. This rock, the heart of which seemed to be porphyroidal, was ascertained, upon examination, to have its paste composed of stony elements of a petro-siliceous nature, irregularly disposed in small grains, in points and in lineaments more or less rounded off, and which tied as it were with each other, varying in colour in proportion to the various degrees of alteration which the ferruginous principle, that is very abundant in this rock, had undergone. The general aspect, however, when the rock was viewed from a certain distance, was the reddish brown, mixed with white spots, shaded with red. In the midst of this paste, there were observed regular spheroidal bodies, from one to three inches in diameter, scattered here and there at unequal distances, and imbedded in the mass. The system of the formation of these balls appeared to be, that they were the result of a globular crystallization, which had taken place rapidly, and not that like geodites they had been formed apart, and enveloped subsequently in a porphyritical substance. This method of crystallization is remarkable, and may be best conceived by representing a circle, into which a multitude of small stony bodies, oblong and compressed, of a petro-siliceous nature, and placed very close to each other, have been directed in radii, proceeding as it were from end to end, from the circumference towards the centre of the circle, and thus assuming the appearance of divergent radii. The globulous solid, which

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has been the result of the process, may be driven with the hammer from the place which it occupies, a hole of the same form being left behind; and around these several spherical bodies in the paste of the stone, and round the spheres, the matter of the paste, according to the tendency it has had to approach them, has formed a kind of aureolus or zones.

Manufactures.

Manufactures are still in a very imperfect state in Corsica. Of the coarse and commonly black wool of the country, only the coarsest kind of stuffs can be prepared. Any thing of a finer description is obtained from abroad, the Corsicans having not yet advanced so far in art as to be able to furnish any thing of that character; and indeed the quantity of wool produced in the country not being adequate, without such supplies, to answer the internal consumption. Linen cloth is also prepared only in small quantities, and of the coarsest kind. There is plenty of leather to be had within the island, but that which is in most common use, and of which their shoes are made, consists merely of skins, particularly that of the wild boar, hardened in the air, without being tanned. Whether it be from poverty or indolence, the true process of tanning, though not unknown here, is but little practised. The little of their leather that is tanned, is so prepared by means of dried wild bay leaves, beaten into a powder, which communicate to it a greenish hue. The use of such materials for this purpose is not by any means the consequence of a scarcity of the more commonly approved materials. On the contrary, bark might be procured very easily, and in great abundance; indeed, it is in large quantities exported into Italy.

The Corsicans prepare themselves the oil which they use in their lamps; they likewise make wax candles, and a few tallow ones. Guns and pistols are manufactured in the country, most of which are of excellent workmanship, likewise great quantities of gun-powder. There are as yet, however, no founderies for cannon in the island, nor do the inhabitants make the bullets for which they have occasion in war. Notwithstanding the apparent facilities within their reach in this department, they are in like manner defective in the art of ship-building. They have, however, a number of small ships, and some of a tolerable size; and considerable prudence and spirit have sometimes been exhibited in the conduct of their naval affairs.

Trade.

The trade of Corsica is by no means considerable. It consists chiefly in the sale of the coral that is found on its coasts, and in an internal traffic of articles for home consumption. It has at various successive periods been placed under different regulations, and subjected to the controul of distinct superintendents. It might easily, however, receive a farther extension than it has ever yet obtained. For this, the situation of the island is not less favourable than its produce. The coast of Corsica every where almost affords good anchorage for vessels of a small draught of water, and there are numerous ports in all directions, into some of which the largest vessels may enter, and where they can be secure from every storm. The principal of these ports are, to the north, Centuri; to the west, San Fiorenzo, Isola Rossa, Calvi, Ajaccio; to the south, Bonifacio; and to the east, Bastia, Maccinajo, and Porto Vecchio. Centuri is indeed small, but might, without difficulty, be considerably enlarged. San Fiorenzo is a gulf which runs about 15 miles up into the country, of a good breadth, and with great depth of water. The gulf itself is often exposed to swellings of the sea from the violence of the west winds, but the various creeks and little bays that occur in it, especially in its southern part, afford good shelter for ships. The bay particularly, which is formed under the tower of Fornali, about two miles from San Fiorenzo, is very much esteemed, and is sufficient for the reception of the largest and most heavily loaded merchant vessels. They can lie there also in perfect safety. Isola Rossa is only a small haven, but it has the advantage of considerable depth of water, and is defended by a small island from the western winds. Calvi is a large and excellent port. Ajaccio is a spacious and commodious harbour, and has a good mole. Vessels may lie there in perfect security. Bonifacio is a very convenient harbour, and has from the most ancient times been much frequented by traders. Bastia is not such a port as might be adequate to the reception of ships of war, but it is very convenient for small vessels, to which its mole affords considerable advantage, both in respect of security, and for the better transaction of business. The islands of Gargona, also of Capraga and Elba, which are in this vicinity, are so happily situated as to prevent small vessels plying in this quarter from being ever without resources when overtaken by a storm. Maccinajo is but an inconsiderable harbour, but very safe and commodious for vessels of a light structure. The most noted of all the harbours of Corsica is Porto Vecchio, which is indeed one of the best ports in Europe. It is so spacious as to be capable of containing a large fleet, being about five miles in length, about a mile and a half broad, and of considerable depth. It has a good bottom, and is so defended by the neighbouring lands as to be secure from the violence of the storms. A majestic natural column, formed by a rock that rises hard by it, makes it easy to be discovered even from a great distance. The greatest inconvenience to which it is subject, arises from the badness of the air, which is occasioned by the marshes in its vicinity.

The abundant supplies which Corsica furnishes in all the departments of natural riches, joined to the facilities which its position and form thus afford for the prosecution of trade, certainly point it out as a place in which it were reasonable to look for a very extensive commerce. That the effect has not corresponded with the apparent causes, may have been owing to injudicious regulations in respect to the object, or to an indifference on the part of the people, the consequence of the state of thraldom in which they have too frequently been held, either by their native or by foreign rulers. In 1769, an exclusive right to the fishings about the island was, by letters patent, vested in two individuals. The Jews of Leghorn, in like manner, had obtained a monopoly of the coral trade. In 1798, it appears that almost the whole commerce of the island was in the hands of foreigners. It consisted chiefly in the export of some oil of an inferior quality —of wax, not equal in beauty to that of Mans—of tar—of raisins and wine—and, above all, of wood in logs and in planks. The little corn which was sent out of the country, returned to it again in meal, in starch, in dry pastes, and sea biscuit. The skins that had been sold in a raw state, were bought back again tanned, and dressed for boots and shoes. The coral fisheries were monopolized by the Neapolitans. The fishery of the thunny was engrossed by the people of Sardinia. The imports, as in all countries without industry and without arts, consisted in tools, utensils, furniture, drapery, iron-ware, and clothes.

Population.

The island of Corsica is not very populous. The intestine wars which have prevailed in it for ages, have

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greatly contributed to its depopulation. In Pliny's time, there were in it no less than thirty-three large towns: their number is now reduced to nine. By an enumeration which took place in 1740, Corsica was found to contain 133 parishes, 427 villages, 26,854 hearths, and in all 120,380 inhabitants. Its population in 1760 had risen to 130,000. According to the state made out for the National Assembly of France, the number of its inhabitants was taken at about 147,000. M. Necker, however, in 1787, estimated them at no more than 124,000. By the last returns in 1802, they were found to amount to 166,813. Corsica is the twenty-third military division of France. For its civil administration, it is divided into two departments, the Golo, so called from the river of that name, and of which the chief place is Bastia; and the department of Leamone, of which the principal town is Ajaccio. The two departments are subdivided into 6 districts, 60 cantons, and 391 communes.

Various accounts of their character.

The Corsicans are well made, but thin and swarthy. They are the descendants of so many nations, and have at different times been placed in such variety of circumstances, that it is difficult to determine their real character. Strabo, who has described them as degraded by a state of servitude, calls them brutal, ferocious, and stupid. Diodorus Siculus, who gives an account of them whilst in the same condition, speaks of them as being naturally better adapted for bodily services than the slaves of other nations; and adds, that in their manner of living together, there was more of humanity and justice than was to be found among any other barbarous people; while in all their civil transactions they had a particular regard to equity. With this account of them Pliny's statement corresponds, who praises them as just, generous, valiant, and humane. This difference in the judgments formed respecting them, may have originated, in part, from their having been observed, in one case, under tyrants who maltreated them; in the other, as in the service of more equitable masters. For the rest, some of those who have most recently paid attention to this subject, have been disposed to give a preference to the authority of the historian over that of the geographer. In modern times, the Corsicans have been painted in the blackest colours by the Genoese, to whom they were subject, and who exercised over them a system of the most oppressive severity. They have received a more favourable, as well as a more impartial judgment, from Frederic the Great and Rousseau of Geneva. The former sets them up as an example of the courage and the truth with which the love of liberty can inspire men; and shews, by a reference to them, how dangerous and unjust it is to suppress so important a principle. The other, by his expression, "I love those characters in which there is stuff," seems to indicate his conviction of their possessing at least some strength and vigour of mind. By some late travellers, this people have been described as turbulent and ferocious; by others, as compassionate and hospitable, and restless only when oppressed. They have been accused of ignorance, indolence, want of probity and confidence, superstition, and above all, an extreme spirit of revenge. This last quality they are said to have been wont to carry to such an excess, that those who conceived their honour injured, would suffer their beards to grow till they had obtained satisfaction for the affront. These beards were styled *barbe di vindetta*. And, from the proverb, *Il Corso non pardona mai ne vivo ne morto*, as well as the sentence that passes current among them, *una inimicizia di sangue*, it seems as if enmities still continued here to be propagated from one generation to another. They have been described as having their habitations in the interior of the island, situated among rocks, on the most inaccessible parts of the mountains, and often removed at a great distance from any land proper for cultivation. They have been represented as at variance, and in a state of alienation even one from another; as careless of improvement, and indifferent as to the enjoyments, the refinements, and the elegancies of life. These traits of character have been traced in their supposed connection with one another, or with various circumstances in their history and actual condition. The oppressive government of the Genoese is said to have led to that vindictiveness of character with which they have been commonly charged. The state of seclusion which they have affected, and their spirit of enmity towards one another, were the consequence of the distribution of the country into several petty principalities, which respectively claimed and exercised for themselves the rights of war and peace. The wars in which they have been so constantly engaged, have had the effect of attaching them strongly to the sports or labours of the chace, and, in an equal degree, have formed them to a disinclination towards the occupations of agriculture, of commerce, and of the sedentary arts, and a mode of life in which hunting, keeping of flocks, and fishing, form the chief employment, has been generally found productive of that character of indolence, which has been stated to be found in an extreme degree among this people. After all, however, there are not wanting other authorities, which represent the Corsicans as sober, brave, intrepid, active, sagacious, and hospitable. Indeed, it will be understood, that, in respect to this people as to others, there may be many traits of their supposed character not universally descriptive, but rather of a local or temporary nature, and, consequently, liable to various modifications. Corsica, when subject to one undivided and regular government, may have been very different from the same Corsica when parcelled out among a multiplicity of inconsiderable chieftains. The thirst of vengeance, inspired probably, or fostered by the sense of a hopeless subjection to injurious treatment, has been found not incompatible with a kind and generous treatment of those who claim the rights of hospitality, and may, in various instances, have given way altogether, or, at least, have been greatly mitigated and restrained under the influence of well constituted tribunals, and of a watchful police. And an indifference to improvement, and listlessness of character, which may have grown amidst circumstances of adversity, may, in better times, have given place to a spirit more honourable and more useful.

Government.

The following is an outline view of the republican government of Corsica. The whole island is divided into nine provinces. Another division of it is into pieves, each of which again is subdivided into a certain number of parishes. This division is properly ecclesiastical; it is, however, also used for civil purposes. The Corsicans, even the peasantry, seldom live in detached situations; the manner is, to gather together in little villages, which are called Paeses. Each paese elects annually, by a majority of votes, a podesta, and two other magistrates, who have the respectable name of *Padri del commune*, Fathers of the community. To these officers, either alone or with certain assessors, nominated also by the people, it belongs to superin-

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tend the economy and police of the village—to call the inhabitants together—and to consult with them on every thing that concerns their interest. Once a year, in like manner, the inhabitants of each village choose a procurator to represent them in the general consulta or parliament of the nation, which is held annually in the month of May, at the city of Corte. The magistrates of each province send thither, at the same time, a procurator, and there are several other honorary members. Before it proceeds to business, there are chosen a president and an orator of this assembly. The president governs during its sitting: the orator reads the different papers subjected to its deliberation. Propositions from the government are addressed to the president: those from the people to the orator. A proposition from the government, when approved by a majority of voices, is immediately passed into a law: one from the people, in the same circumstances, may be suspended by the government, but on the principle of its being subject afterwards to a proper responsibility. The procurators of the several provinces choose their representatives in the supreme council for the ensuing year, one of whom is elected into the office of great chancellor. These counsellors, with the general of the kingdom, are to form the executive power of the whole nation.

The general holds his office for life. He is perpetual president of the supreme council of nine. He votes in all questions, and in case of an equality has a casting vote. He is absolute commander of the troops or militia of the island.

The procurators of the provinces choose also the provincial magistrates for the current year. This magistracy is regularly composed of a president, two consultors, an auditor, and a chancellor; but the number is varied in different provinces, as is, indeed, also the magistracy in the different villages.

Both the magistrates of the villages, and the provincial magistrates, have a certain jurisdiction assigned to them in civil causes. The provincial magistrates have also, within determined limits, a jurisdiction in criminal matters. The chief judicial authority is vested in the supreme council. The ultimate rule of judging, is the civil and the canon laws, together with the particular laws of Corsica.

Besides the other elections, the procurators in the general consulta choose some persons of high credit and respect as syndicatori, whose office it is to make a tour through the different provinces, to hear complaints against the magistrates, to redress grievances, and, in short, to promote every where industry, order, and general improvement.

The hereditary feudal jurisdictions, which had place in Corsica as in other parts of Europe, having, by a fortunate concurrence of accident and wisdom, been so moderated as to coincide with the spirit, and even, in some degree, to promote the objects aimed at in this constitution of its government, have, in latter times, been attended with little inconvenience, indeed may, in some respects, have been productive of advantage.

Religion.

The religion of Corsica is the Roman Catholic, in which these islanders are very zealous. They are, however, decidedly inimical to the temporal power of the church. The Corsican bishops are five in number, and are suffragans of the archbishop of Pisa. The tithes in Corsica are, in general, about a twentieth part of every production. Several of the inhabitants have made a composition with the church for their tithes; and the descendants of the Caporale, on account of the services of that family in expelling the Saracens from the island, are, by special privilege, exempted from paying any tithes. There are, in Corsica, sixty-five convents of mendicant friars of different orders, which depend for their support altogether on the charity of the people. There are two colleges of Jesuits, two convents of Dominicans, five of Servites, and one of missionaries; all of which, as also the Carthusians of Pisa, have very good possessions. There are no nunneries in Corsica.

Learning.

The state of learning in this island, amidst the confusions and distresses to which it has, during the lapse of ages, been subject, has necessarily been at a low ebb. In 1764, a university was established in the city of Corte, of which the professors have mostly been fathers of different religious orders. About the same period, there were also in that city a printing-house and a bookseller's shop, but both conducted by a foreigner.

Language.

The language of the Corsicans is good Italian, tinctured a little with Genoese corruptions, and with some remains of the dialects of the barbarous nations. Their pronunciation is coarse, but they write the language in a great degree of perfection,

Arts.

A turn for the arts is prevalent amongst the Corsicans. Painting has not yet flourished among them, but they succeed well in music and poetry.

Army.

The warlike force of Corsica consists chiefly in a bold and resolute militia. The people are trained to arms from the time that they are able to bear them. Officers are appointed over the several districts, who call out the men, and otherwise give such directions as the occasion may require. The arms of the Corsican soldier are a gun, pistol, and stiletto, with a cartridge-box for his ammunition. The only instrument of warlike music that is used, is a large Triton shell pierced in the end, with which a sound is made loud enough to be heard at a great distance.

By whom first peopled.

Corsica was probably first peopled by the inhabitants of the opposite coast of Italy. It was successively conquered by the Carthaginians, Romans, Vandals, Goths, Lombards, and Saracens. The French, under Charles Martel, entered the island about the year 725; and the family of the Colonnas established themselves in the sovereignty of it about the eighth century. Owing to the family divisions, the troubles, and the consequent anarchy which for some centuries after this period prevailed in the island, an opportunity was afforded to the popes of interfering, and of claiming for themselves an authority which was now so ill exercised. Pope Gregory VII. excommunicated the Genoese, branding their occupation of Corsica as a usurpation of ecclesiastical property. In 1071, the island was sold by Urban II. to the Pisans. Genoa disputed the sale; and the island was afterwards divided into two rival republics. The Pisans not being able to come to any agreement respecting it with the Genoese, ceded again their part of the island to Pope Urban IV.; and Boniface VIII. as if the possession of a part gave him also a title to the disposal of the rest, made a present of the whole island to the kings of Arragon, from whom it returned under the yoke of Genoa.

History.

An assembly of the Corsicans as a national body, the first of which we have received any notice, was held in the year 1359, for the purpose of taking into consideration the evils to which they were subjected, both from the incursions of foreigners, who disputed with each other the possession of their country, and from the animosity of their nobility, who in certain districts had assumed the title and despotic authority of kings. A great part of the island was held at this time by the Genoese. To deliver themselves, therefore, from all other foreign authority, that of the Pisans and the Arragonese, as well as from the oppression of their own petty tyrants, the Corsicans, by the advice of the brave Sambuccio, requested the aid of this people, and associated them with themselves in the sovereignty of the whole island. This sort of mixed government was, however, only of a few years duration. The Corsican chiefs, weary of their state of subjection to a foreign yoke, assembled privately in 1380, and having chosen Henry de la Rocca to head them, they took, under his command, several of the Genoese garrisons. But Rocca, in the midst of these triumphs, having been killed in an action, the Corsicans were obliged again to submit to Genoa, in the fate of which republic they for a long time participated, being subject sometimes to the French, sometimes to the Milanese, and sometimes to the Neapolitans. In the end of the 15th century, they submitted to the lords of Piombino, by whom the island was sold to the bank of St George. This occasioned new stipulations with the Genoese; but these were soon disregarded, and the persons appointed to govern in the name of the bank had recourse to the most oppressive measures, subduing the opposition which they encountered by means of fire and sword. Eighteen parishes were destroyed, more than a hundred villages were burnt, and the chief men of the island were treacherously put to death. By such violent proceedings, the indignation of the people was roused. The French, who were at that time enemies to the Genoese, assisted the Corsicans to break their chains, and a most violent and unrelenting civil war was set on foot. Neither party gave to the other any quarter, and such as escaped the murderous sword, were sold as slaves to the Turkish corsairs who hovered about the island. In the progress of this contest, various dismal catastrophes occurred, and many examples were exhibited of a noble intrepidity, of the most persevering fortitude, and occasionally also of the milder though not less estimable virtues. It was the policy of the state of Genoa to govern entirely through fear. Corsica was considered merely as a colony destined to enrich its capital. All the exports of that state were directed to Genoese ports; and, in years of scarcity, the island being stripped of its provisions, the Corsicans themselves were frequently exposed to the horrors of famine, while their merciless and unfeeling tyrants lived in abundance.

The deliverance which they could not themselves effect, the Corsicans would willingly have obtained even at the expense of becoming subject to another master. They offered their island to Louis XIV. at the time that he was engaged in the bombardment of Genoa; but he having declined their offer, they were forced to remain in submission to their oppressors. Some incidental, and apparently trifling circumstances, however, excited anew a spirit of determined resistance on their own part, which seemed to promise a complete emancipation from the power of the Genoese. The latter people were obliged even to have recourse to the aid of Austria. But not with this accession of force could they terrify men who had resolved to be free. The Corsicans would listen to no proposals, but declared themselves willing to submit to every evil, rather than stop short of the object at which they had aimed. Necessity, however, got the better of their resolution, and, after the contest had been continued for 4 years, they entered into an agreement under the guarantee of the emperor. But the troubles were by this means but incompletely allayed, and soon revived. The Corsicans openly declared themselves independent, and set about making suitable preparations for supporting their pretensions. At this critical juncture, a seasonable aid was brought them by Stephen Theodore, son of Anthony, baron de Neuhoff. After various adventures in different countries of Europe, this nobleman had got acquainted with the Corsican malcontents confined at Genoa, and interested himself strongly in their behalf. Having, by persevering exertion, obtained an ample supply of such things as were most needful for a people circumstanced as the Corsicans then were, he set sail for their island, where he was received by them as a protecting deity. Without consulting the dictates of prudence, they conducted him to Corte amidst universal acclamations; and, in a general assembly of the people, he was proclaimed king of Corsica and of Capraja, under the name of Theodore I. Being well supported in the moment of enthusiasm, he took some fortresses of the enemy, and under pain of death, should they ever again set foot in the island, declared the Genoese banished from Corsica. The Genoese, on their part, by a policy too often resorted to by republics, set a price on the head of the new monarch. The baron, in the mean time, assumed all the appendages of royalty, coined money, established tribunals, and used every effort to maintain, and farther to extend, the ground he had gained. But while by these means he prevented or stifled discontent among his own subjects, he was exposed to danger from abroad. As he had at first landed on the island from an English vessel, the French imagining that the British government had some designs on Corsica, resolved to anticipate them. In the prosecution of the measures which he thought it incumbent on him to take on this occasion, the Corsican monarch was involved in difficulties, of which the conclusion was, that, having languished several years in prison for debts, he at last died in extreme indigence on the 11th of December 1755. Some time before the death of this prince, an accommodation had taken place between the Corsicans and the Genoese under the guarantee of France. A nobleman, however, named Gaffori, having communicated to his countrymen the hatred which he himself felt towards the oppressors, the war was renewed, and though the fate of the general was to be treacherously assassinated, it was not till the signal zeal which he had manifested for the welfare of his country had been crowned with some degree of success. Pascal Paoli was now recalled from Naples, whither he had gone for shelter, and when but 29 years of age was made head of the republic, in the government of which he was to be assisted by two counsellors of state, and one of the most reputable persons from each district, who were all to be changed monthly. Paoli, who had often before been opposed to the Genoese, conducted himself so well both in the council and the army, as to give great uneasiness to that people, who, in consequence, sent a deputation to a general assembly convoked at Vescovato, to offer peace. The Corsicans, however, would be satisfied with nothing less than a distinct acknowledgment of them as a free and independent nation. In support of this determination, the general enrolled all the inhabitants capable of bearing arms, disciplined his troops, caused money to be coined, and made his administration at once feared and respected. The Genoese were driven from the open country, and shut up in the maritime towns. They again, however, obtained assistance from France. In 1764, the French general Marboeuf, an

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officer of considerable talents, landed with six battalions. The caution and political prudence which Paoli now thought it his duty to employ, nor yet the more active exertions in which afterwards he had occasion to engage, proved eventually sufficient for the safety or for the maintenance of the independence of his country. It was expected that England would take part in the quarrel; but this hope having been disappointed, and the sovereignty of the island having been renounced by Genoa in favour of the king of France, Corsica was, in 1768, invaded by a French army of 5000 men, under the command of the Marquis de Chauvelin, supported by two ships of the line, two frigates, and six armed brigantines. In the furious contest which ensued, numbers, military science, and discipline, were opposed to an almost unarmed multitude, to enthusiasm, bravery, and the cause of liberty. It was not, however, without considerable difficulty, and till after the aid had been obtained of some farther reinforcements, that the subjugation of Corsica was effected by Count de Vaux in 1769. Paoli having defended his country to the last, escaped in an English ship to Leghorn, whence he afterwards repaired to London. Both he and the Corsicans who acted along with him, are highly complimented by the celebrated General Dumourier, (who served in the French army as adjutant general,) in the memoirs which he has published of his own life.

Paoli having taken the oath of fidelity to the constituent assembly of France, returned again to Corsica in 1792, when he was elected mayor of Bastia, commander in chief of the national guard, and president of the department. On the execution of Louis XVI. when there was every prospect that a civil war was about to take place in France, Paoli thought the opportunity favourable for rescuing his country from all subjection to a foreign yoke. Having determined, therefore, to call in the assistance of England, he invited Lord Hood, who was then at Toulon, and who had recently been foiled in an attempt against Corsica, to invade it anew. An expedition sailed from the bay of Hieres on the 24th of January 1795, for the express purpose of recovering it from the possession of the French. The towers of Morsella, Fornelli, and San Fiorenzo, were taken by the troops under the command of lieutenant general Dundas, and Bastia and Calvi having likewise yielded to the English, the union of Corsica with the British empire was unanimously voted in a general consulta that was assembled at Corte. This proposition was readily accepted on the part of the English commissioner Sir Gilbert Elliot, now Lord Minto, and he was in consequence immediately invested with the dignity of viceroy. Corsica did not however long continue an appendage of the British crown. Jealousies arose between the English viceroy and general Paoli. The latter returned to England, but, before his departure, exhorted his countrymen to continue steady in their allegiance to Great Britain. This exhortation was not much regarded by the Corsicans. The splendour of the victories of their countryman Bonaparte in Italy, determined them to return to their allegiance to France. The English troops accordingly evacuated the island, and Corsica has ever since continued a province of the French empire.

See Boswell's *Account of Corsica*; Herbin *Statistique de la France*; *Memoirs of Corsica*; *Mœurs et Coutumes des Corses, &c.* par G. Faydel; *Voyage en Corse*, par l'Abbé Gaudin; *Description de la Corse, &c.* par Frederick, colonel sous Theodore, roi de Corse; *Viaggio di Licomedi*, (Arrighi) in Corsica, &c.; *Mineralogical Account of the Island of Corsica*, in a letter from M. Rampasse to M. Faujas de St Fond, in *Philosophical Magazine*, vol. xxx.; Anquetil's *Summary of Universal Hist.* vol. vii.; Peuchet *Diction. Univers. de la Geogr. Commerç.* (K)

Cortes.

CORTES, Fernando, the conqueror of Mexico, was born at Medellin, a small town in Estremadura, in the year 1485, and descended from a family of noble blood, but of small fortune. He was originally intended for the law, and studied for a while at Salamanca, where he devoted himself chiefly to active sports and martial exercises. At this period of his life, his disposition was so turbulent, and his habits so dissipated, that his father was glad to comply with his inclination, and send him forth as an adventurer in arms. Being disappointed in his views of serving under the great captain in Italy, a fair opportunity soon offered of trying his fortune in the new world, by the appointment of his kinsman Ovando to the government of Hispaniola, in the year 1502. He was prevented, however, from accompanying the governor, in consequence of an unlucky accident which he met with, in attempting to scale a lady's window; he brought down an old wall upon himself, and was so much bruised as to be unfit for the voyage. He reached Hispaniola or St Domingo in 1504, and met with a cordial reception from his kinsman. He accompanied Velasquez in his expedition to Cuba, which was conquered in 1511. Velasquez, seized with that spirit of enterprise, which was so common and so inviting in that age of wonders, sent Grijalva on a voyage of discovery, who returned with the important intelligence of having discovered the rich and populous kingdom of Mexico, or New Spain. The next object was to accomplish the conquest of this newly discovered country. Velasquez fitted out an expedition for this purpose, chiefly at his own expence; but as he was of a jealous and suspicious temper, he could not easily find a commander whom he could trust with the conduct of such an important enterprise. Cortes was warmly recommended to him, and his choice was decided by his known activity and intrepidity, and also by the little personal consequence which he then possessed.

Scarcely had he been appointed to the command, when the suspicions of the governor were excited; and had he not hastened his departure with the utmost expedition, he would have been stript of the means of his future glory. Cortes sailed straight for Trinidad, and afterwards touched at the Havannah, to engage adventurers, and provide the necessary equipments for his small armament. To both these places Velasquez sent orders to deprive him of his commission, and commanded his lieutenant at the Havannah to send him a prisoner to St Jago. Cortes defeated all these measures, and after his plans were completely matured, he declared to his followers the jealous suspicions of Velasquez, and his determination to deprive them of the rich spoil which they had in prospect. They received the intelligence with the utmost indignation, and offered to shed the last drop of their blood in maintaining the authority of their commander. Cortes, on his part, swore that he would never desert soldiers who had given him such a signal proof of their attachment.

He now therefore prepared to sail, determined to assert his independence, and to renounce all his allegiance to Velasquez. His fleet consisted of eleven vessels; the largest of a hundred tons burden, which was dignified with the name of admiral: three of seventy or eighty tons; and the rest small open barks. On board this fleet were 617 men; of whom 508 belonged to the land service, and 109 were seamen or artificers. Only 13 of the soldiers were armed with muskets, 32 with cross-bows, and the rest with swords and spears. They had 16 horses, 10 small field pieces, and four falconets.

Such was the expedition fitted out by a few private adventurers to make war on a monarch, whose dominions exceeded in extent, all the kingdoms subject to the Spanish crown. They did not however engage in this enterprise with any fears, or with any doubts of their success: they were stimulated by avarice, and enthusiasm; the first, made them submit to any hardship and encounter every danger, whilst the second made them believe that they were fighting for the glory of God, and, on this account, sure of his protection. They erected the cross as their standard, with this inscription, *Let us follow the cross, for under this sign we shall conquer.* Thus, under the great emblem of peace on earth, they commenced an expedition of bloodshed and plunder.

Cortes touched at the island of Cozumel, where he had the good fortune to redeem Jerome de Aguilar, a Spaniard, who had been eight years a prisoner among the Indians, and who was afterwards extremely useful as an interpreter. Having left Cozumel he proceeded to Tabasco, where he found the natives unfriendly, and from thence he sailed to St Juan de Ulua. As he entered the harbour, a canoe full of people, among whom appeared to be some persons of distinction, approached his ship with signs of peace and friendship. They came on board without fear or distrust, and addressed him in a language totally unknown to Aguilar his interpreter. This circumstance caused great embarrassment, from which, however, he was fortunately relieved by a female slave, whom he had received from the Cazique of Tabasco. She perfectly understood the Mexican language, as she was a native of Mexico, but had fallen into the hands of the Tabascans, among whom she had resided long enough to learn their language, without losing her own. She was afterwards called Donna Marina, and makes a conspicuous figure in the history of the new world. She explained the words of the Mexicans in the Yucatan tongue, which Aguilar translated into Spanish. The strangers proved to be deputies sent by Teutile and Pilpatoe, two officers entrusted with the government of that province, by Montezuma, emperor of Mexico: and the object of their mission was to enquire into the intention of Cortes in visiting their coast, and to offer him assistance in prosecuting his voyage. Cortes landed his troops, horse, and artillery; and the unsuspecting natives, with a fatal alacrity, assisted him in fortifying a camp, and erecting huts for his men.

Next day the two governors of the province entered the camp with a numerous retinue, and Cortes received them with much formal ceremony. He told them that he was the ambassador of Don Carlos of Austria, king of Castile, the greatest monarch in the East, and that he was entrusted with propositions of such importance, that he would impart them to none but the emperor himself. The officers were much disturbed at this intelligence, which they knew would not be agreeable to their master. They endeavoured, however, to conciliate the affections of the Spaniards by presents, consisting of fine cotton cloth, plumes of various colours, and ornaments of gold. These were fatal presents; they tended only to whet the avarice of Cortes and his companions, and he demanded in a more determined manner than ever, to be admitted to a personal audience with their sovereign. During this interview, several painters, in the train of the Mexican chiefs, were employed in delineating the ships, horses, artillery, soldiers, &c. on white cotton cloth, which Cortes was informed, was to be sent to the emperor, to give him a proper idea of what words could not represent. On learning this, he made his men go through their various evolutions, exhibited the power and agility of his horses, an animal till then unknown to the Mexicans, and last of all displayed the terrific thunder of his artillery. They beheld all the rest with astonishment, but when they heard the explosion of the guns, and saw the dreadful havoc which the balls made among the trees, they were filled with dread and horror: some ran away, others fell to the ground, and it was with some difficulty that Cortes could regain their confidence.

An account of all these things was sent to Montezuma, who immediately dispatched messengers to Cortes with rich presents, but with a peremptory order to leave his dominions. The Spanish commander on his part still insisted on a personal interview. Whilst negociations were carrying on between the Mexicans and Spaniards, Cortes was not perfectly easy on his part. He was sensible that he only held an usurped authority; and was afraid lest the representations of Velasquez should induce the Spanish court to recal him from the great enterprise which he had in view. To obviate these difficulties, he founded the colony of Vera Cruz, in the king's name; pretended to resign his authority into the hands of the new magistrates whom he himself had constituted, and was, as might be expected, conjured by them to resume the command. At the same time he prevailed on the magistrates of the new colony to write a letter to the king, requesting the confirmation of what they had done. Cortes himself wrote on the same occasion; and whilst he gave a most exaggerated account of the country which he was about to conquer for the crown of Spain, he was fortunate in having it in his power to accompany his representations with valuable specimens of its productions.

All his measures, however, had nearly been thwarted by the mutinous spirit of his followers. The partizans of Velasquez, several of whom were among his troops, were continually endeavouring to excite sedition; and many of his soldiers became alarmed at the prospect of the dangers which they must encounter. A conspiracy was formed in consequence against Cortes, which he had the good fortune to discover and defeat when it was on the eve of being carried into execution.

To engage his followers completely in the enterprise on which his own heart was so fully set, and to cut off the very possibility of abandoning it, he formed the resolution of destroying his fleet. It was of the utmost consequence, however, not to estrange the affections of his adherents, by any seemingly rash or despotic act originating in his own views and feelings: And his address and power over the minds of his followers are conspicuously displayed, in making them voluntarily consent to such a sacrifice. He pointed out the leaky and unserviceable state of the ships, the great accession of strength they would derive from the sailors who manned them; and above all, he pressed upon them the necessity of fixing their hopes on the rich country which lay before them. In consequence of these representations, the ships were drawn ashore, stript of their sails, rigging, iron-work, &c. and broken in pieces. And thus 500 men consented to shut themselves up in a hostile country, leaving themselves no alternative of safety but their own valour.

Several circumstances contributed to the success of Cortes, besides the superiority of European weapons, valour, and discipline. The emperor of Mexico was indeed powerful, but he was cruel and despotic, and the yoke which he had imposed on the neighbouring nations was a yoke of iron; and nothing but fear prevented them from attempting to shake it off. Cortes soon had an opportunity of discovering this; and he saw all the advantages to be derived from it. The cazique of Zempoalla sent messengers to him, imploring his assistance against the tyrant of Mexico; and Cortes removed to his capital, where he was received with every demonstration of friendship; which, however, he nearly forfeited by the imprudence of his zeal, in ordering his soldiers to destroy the idols in the chief temple of Zempoalla; and to erect an image of the Virgin Mary in their stead. This unlucky affair being adjusted, Cortes proceeded on his march towards Mexico; and was furnished by the cazique of Zempoalla with provisions, and with 200 Indians to carry burdens and perform other servile offices. This was of great consequence in a country where beasts of burden were unknown.

Nothing memorable happened till he reached the confines of Tlascala. The inhabitants of this province were a warlike people, and implacable enemies of the Mexicans. It might therefore have been expected that they would have joined Cortes: but they distrusted his professions; and as they saw him determined to visit the emperor of Mexico in his capital, they naturally concluded that it was to seek his friendship. They therefore attacked Cortes with all their forces, and with the most determined spirit of animosity. They sent a supply of provisions to the Spaniards, desiring them to eat freely, as they could have no pleasure in eating famished victims, and as such sacrifices would not be acceptable to their gods. After great efforts and incredible slaughter on the part of the Tlascalans, they were at last disposed to peace. The language of their ambassador is descriptive of the mixed feelings of terror and respect with which the Spaniards were viewed by the native Americans. "If," said they, "you are divinities of a cruel and savage nature, we present to you five slaves, that you may drink their blood and eat their flesh. If you are mild deities, accept an offering of incense and variegated plumes. If you are men, here is meat and bread, and fruit to nourish you." A peace was concluded to the satisfaction of both parties, and particularly advantageous to Cortes, as the Tlascalans remained ever after firmly attached to him, and he had reason to ascribe the conquest of Mexico chiefly to their assistance.

Having remained in Tlascala twenty days to refresh his troops, and conciliate his new allies, he proceeded on his march to Mexico, accompanied by six thousand Tlascalans. Montezuma, after much hesitation, had at last promised Cortes a personal interview, and informed him that he had given orders for his friendly reception in Cholula. It appears, however, that a deep plot had here been laid for his destruction. The Cholulans refused to admit into their town their ancient enemies the Tlascalans. They received Cortes, however, and his soldiers, with much appearance of cordiality. The Tlascalans had warned him to be on his guard; and two of them having entered the town in disguise, had an opportunity of seeing what was going on: they acquainted Cortes that the women and children of the principal inhabitants were retiring in great numbers every night, and that six children had been sacrificed in the principal temple, a certain indication that some great warlike enterprize was in contemplation. Marina, the interpreter, also had learned from a Cholulan woman, that the destruction of the Spaniards was resolved on. On this information, Cortes resolved to anticipate his enemies, and fell upon them so unexpectedly, that though preparing for his destruction, they could make no resistance, and 6000 of them were slain without the loss of a single Spaniard.

He now advanced directly towards Mexico, from which he was only twenty leagues distant, and had the satisfaction to observe, in every step of his progress, evident marks of disaffection to the Mexican government; and his own ardour and that of his men was farther kindled, when they beheld from the mountains of Chalco the vast plain of Mexico covered with cultivated fields; when they saw a lake resembling a sea in extent, encompassed with large towns, and discovered the capital itself rising on an island in the middle, adorned with turrets and temples. The whole prospect was so different from any thing they had ever seen, that they were almost disposed to think it a scene of enchantment. As Cortes approached the city, Montezuma shewed his irresolution, by sending various messengers, sometimes permitting him to advance, at other times requiring him to retire, according to the fluctuation of his feelings. Cortes paid no attention to these opposite requests, but continued his march along the causeway which led to the city, observing the greatest circumspection, but without betraying any symptoms of suspicion.

As he approached, Montezuma came out to meet him, attended by a splendid retinue, and with all the insignia of regal magnificence. He was carried in a chair or litter, richly ornamented with gold and feathers of various colours, on the shoulders of four of his principal favourites. Cortes dismounted to receive him, at the same time Montezuma alighted from his litter, and approached with a stately pace, his attendants covering the street with cotton cloths, that he might not touch the ground. Cortes accosted him in the European manner, and he returned the salutation by touching the earth with his hand, and then kissing it. This was the way in which inferiors saluted their superiors, and his subjects were astonished to see such condescension in their haughty monarch. They concluded that the persons to whom he paid such extraordinary marks of respect must be something more than human. Montezuma conducted Cortes to a lodging surrounded by a stone wall, with towers at proper distances, and its apartments and courts were sufficiently large to accommodate both the Spaniards and their Indian allies. The first care of Cortes was to provide for his security, by planting his artillery in such situations as to command the different avenues leading to the place appointed for his residence; and though Montezuma told him in the evening that he and all his dominions were subject to him, as he was convinced that the Spaniards were the powerful strangers foretold in some of their prophecies, who were to reform and new-model the Mexican state, yet Cortes observed the same vigilant discipline as if he had been in sight of the enemy's camp.

The city of Mexico was built on some small islands in an extensive lake, and was connected with the land by causeways. The situation of the Spaniards, therefore, was extremely critical, should Montezuma conceive any hostile intentions against them. It was easy to cut off their retreat, by breaking down the bridges and causeways; and with all the advantages which the Spaniards possessed, they were alarmed at the thoughts of being shut up in the city amidst sixty thousand hostile inhabitants. And it was not long till Cortes had good cause of alarm. He had learned that Escalante, whom he had left in the government at Villa Rica, had been mortally wounded in a rencontre with the Mexicans, and that one of the Spaniards being taken prisoner, his head was cut off, and after it had been carried in triumph through various cities, to show that the Spaniards were not immortal, had at last been brought to Montezuma. Cortes therefore determined to adopt a bold measure; to seize Montezuma in the midst of his capital, and carry him as a prisoner to the Spanish quarters, that he might employ his sacred authority in accomplishing the plans which he had in view; an expedient which has since been adopted, after his example, on various occasions, and with various success. He went to Montezuma, accompanied by his most determined officers, and a chosen band of soldiers: he upbraided him as the author of the unprovoked attack upon the Spaniards at Villa Rica. Montezuma asserted his innocence, and offered to bring the officer who commanded on that occasion a prisoner to Mexico. Cortes replied, that it was necessary, in order to remove the suspicions of his followers, that he should leave his palace, and take up his residence in the Spanish quarters. The Mexican prince heard the proposal with the utmost indignation, and said his people would protect him from such an insult. Cortes reasoned and remonstrated in vain; and the altercation had continued three hours, when one of Cortes's officers exclaimed, "Let us seize him instantly, or stab him to the heart." Montezuma was terrified by the fierceness of his voice and gestures, and suffered himself to be carried to the Spanish quarters, amidst the tears and lamentations of his people.

Cortes wishing to impress the Mexicans with the idea that to put a Spaniard to death was the greatest of all crimes, caused the officer who commanded against Escalante, his son, and five other principal officers, to be tried by a Spanish court martial: they were condemned to be burnt alive; the sentence was executed in the presence of the sorrowful Mexicans; and the weapons collected in the royal magazines for the defence of the state, composed their funeral pile.

Cortes completely subdued the mind of Montezuma by these proceedings, and for the space of six months made him the willing instrument of promoting his purposes. Montezuma gave orders to his people to bring part of the naval stores which the Spaniards had deposited at Vera Cruz; others were commanded to cut down and prepare timber, and by these means the Spanish carpenters were soon enabled to complete two brigantines, which gave Cortes the command of the lake of Mexico. He next prevailed on Montezuma to declare himself a vassal of the King of Spain: encouraged by this facility, Cortes proposed that he should establish by royal authority the Christian religion. But however complying he had been in other respects, he obstinately resisted this proposal. Provoked by this resistance, Cortes led out his soldiers to throw down, by force, the idols in the grand temple of Mexico. Both priests and people were instantly in arms, and Cortes's zeal was forced to yield to his prudence.

From that moment the Mexicans were determined to attempt the expulsion or destruction of the Spaniards: and Montezuma assuming unusual spirit, told Cortes that since the object of his embassy was now accomplished, it was the will of the gods, and of the people of Mexico that he and his followers should instantly depart. Amidst these transactions, a Mexican courier arrived with intelligence that some ships had appeared off the coast. Cortes fondly imagined that these brought reinforcements from Spain, and a confirmation of his usurped authority. How great was his mortification when he heard that it was a formidable armament fitted out against him by Velasquez, governor of Cuba. This armament consisted of eighteen ships, having on board eighty horsemen, eight hundred foot soldiers, a hundred and twenty cross-bowmen, and twelve pieces of cannon, and Pamphilo de Narvaez had the command. Cortes, having endeavoured to persuade Montezuma that the strangers newly arrived were his friends, with whom he must have an interview, left Pedro de Alvarado with a hundred and fifty men to take charge of Montezuma, and the Mexican capital, and marched instantly against Narvaez with about two hundred and fifty men. He negociated with his followers, held out the alluring prospects of wealth and honour, and had undermined their fidelity before he commenced the attack, which was conducted in the night, and with complete success. Narvaez was taken prisoner, and almost all his men joined Cortes.

During Cortes's absence, the Mexicans had taken up arms to expel their invaders; they had been wrought up to the highest pitch of fury, and forgetting the terrors which the Spaniards had inspired, they attacked them in their quarters, killed several of them, and destroyed their magazines, together with the two brigantines which Cortes had built to give him the command of the lake. On receiving an account of these proceedings, he hastened back to Mexico with all his forces, where he found the Mexicans burning with implacable animosity. He attacked them repeatedly without effect; though immense numbers were slain, fresh troops rushed forward to devote themselves, till the Spaniards, wearied with slaughter, were forced to retire. He next brought forward Montezuma to persuade them to cease from hostilities. Though they adored their prince, his proposal was received with so much indignation, that they discharged a volley of arrows and stones, by which the unhappy monarch was killed.

Cortes now resolved to retreat from Mexico: but finding it necessary to dislodge the Mexicans from a high tower which overlooked the Spanish quarters, he forced his way to the top of the battlements, where two young Mexicans, seizing him in their arms, threw themselves from the tower, in the hopes of dragging Cortes along with them. He disengaged himself by his strength, and the gallant youths perished in endeavouring to deliver their country.

The Spaniards now prepared for a precipitate retreat, which they resolved to attempt in the dead of night, with a view to elude the vigilance of the Mexicans. Their motions, however, had been carefully watched, and whilst they were proceeding silently along the causeway, they were suddenly alarmed by the warlike shouts of the Mexicans, and assailed with innumerable weapons. The conflict became tremendous. Cortes effected his retreat, the bodies of the slain serving as a bridge across the breaches in the causeway; and when he mustered his forces next day, he found that he had lost many of his best officers, half his followers, all his artillery, and almost all his horses. He continued his retreat towards the territories of the Tlascalans, being continually harassed by the Mexicans, who were defeated in a great battle at Atumba. The Tlascalans still retained their animosity against the Mexicans, and burned to revenge the death of their countrymen who had fallen in the service of Cortes.

Notwithstanding of his disasters, Cortes determined to persist in his design of conquering Mexico. Fortune seconded his views; an avowed enemy sent forces to destroy him, an envious rival endeavoured to supplant him; he managed to seduce the forces of both, and to attach them to his service. With these reinforcements, and ten thousand Tlascalans, he marched again towards Mexico, six months after his retreat from that city. His first care was to build vessels, to give him the command of the lake. The Mexicans easily perceived the advantage which this would give him; and therefore their first attack was directed against his fleet of brigantines. Guatimozin the reigning emperor, the nephew and son-in-law of Montezuma, hoping to supply by numbers what he wanted in force, collected such a multitude of canoes as covered the face of the lake. The whole armament, however, was dissipated with such slaughter, that the Mexicans found themselves still more inferior on this new element, than they had hitherto been on land.

Cortes at first proceeded slowly and cautiously in his operations, till disconcerted by the length and difficulties of the siege, he resolved to attempt to take the city by storm. A general assault was ordered; the Spaniards advanced with impetuosity, bearing down all opposition. Cortes had taken the precaution to secure a retreat if necessary, and for this purpose appointed one of his captains to fill up the canals and gaps of the causeway, as the main body advanced. But this officer, thinking it inglorious to be thus employed whilst his companions were pressing on to victory, neglected the important trust committed to him, and hurried on to mingle with the combatants. Guatimozin, with the skill of an experienced general, instantly profited by this mistake. He ordered the troops in front to slacken their efforts, to allure the Spaniards to push forwards, whilst he dispatched a large body of chosen troops to take possession of the great breach in the causeway which had been left open. As soon as this movement was completed, the priests struck the great drum consecrated to the god of war, when the Mexicans in front rushed upon their assailants with irresistible impetuosity, and forced them back to the causeway, where their retreat was cut off. All Cortes's efforts were now directed to save such of his men as were precipitated into the breach. He himself narrowly escaped being taken, having been seized by six Mexican captains, who were hurrying him off in triumph. From this perilous situation he was rescued by two of his officers, at the expence of their own lives: but he lost sixty Spaniards, forty of whom fell alive into the hands of the enemy who, on the approach of night, were sacrificed to the god of war, within sight and hearing of the Spanish troops, whose minds were filled with indescribable horror.

The heads of the sacrificed Spaniards were sent to the principal men in the adjacent provinces, with an assurance that the god of war had declared with an audible voice, that every Spaniard should be destroyed in eight days. This prediction was universally believed; and Cortes found himself almost entirely deserted by his Indian confederates. He was therefore compelled to suspend all military operations till the fatal period should elapse; when the Indians, convinced that the god of war had deceived the Mexicans, returned with greater confidence than ever to their alliance with Cortes, who, according to his own account, soon found himself at the head of a hundred and fifty thousand Indians. By his brigantines and his numerous Indian auxiliaries, he was now enabled to shut up the city so completely, that famine began to make dreadful ravages amongst the besieged. The Mexican nobles advised Guatimozin to retire from a place which now appeared untenable; the Spaniards being already in possession of nearly three-fourths of the city. To accomplish this purpose, they endeavoured to deceive Cortes by various proposals of submission; but he was too vigilant to be deceived; Guatimozin was taken in attempting to escape across the lake; and with him fell the city and empire of Mexico. See Mexico.

Cortes had all along acted without any authority from the court of Spain; and after he had completed the reduction of Mexico, an officer was sent to supersede him, to confiscate his effects, and examine into his conduct. The person entrusted with this commission was a man of no talents; and being conscious of his weakness, he abandoned a country which he was unworthy to govern. Cortes's authority was at last confirmed by a warrant from the crown, and he was appointed captain-general and governor of New Spain. His enemies, however, still continued to plot against him, and misrepresented his conduct so grossly, that Charles was induced to order a solemn inquest into his conduct, to seize his person, and to send him, if that should be thought expedient, a prisoner to Spain. Cortes disdaining to stand a trial in a country which was filled with the glory of his exploits, resolved instantly to return to Spain, and there face his accusers.

His appearance in Spain removed every doubt that had been entertained with respect to his intentions. He appeared surrounded with all the splendour which fame and riches can confer: the emperor received him with the highest marks of distinction and respect; conferred upon him the order of St Jago, the title of Marquis *del Valle de Guaxaca*, together with the grant of an ample territory in New Spain; and as his manners were correct and elegant, the emperor admitted him to the same familiar intercourse with himself that was enjoyed by noblemen of the first rank.

But though Cortes was thus distinguished, the emperor was not fond of entrusting such extensive power in the hands of a man whose influence might be dangerous. Cortes therefore returned to Mexico, dignified with new titles, but with diminished authority. The supreme direction of civil affairs was placed in a board called the *Audience of New Spain*; the military department, with powers to attempt new discoveries, were left in the hands of Cortes. This division of authority cramped the efforts, and embittered the life of Cortes. His zeal for new discoveries remained, however, unabated. Having fitted out an armament, he took the command in person, and after enduring incredible hardships, discovered the large peninsula of California. Cortes had a considerable time before traversed an immense tract of country to punish the treachery of Christoval de Olid, one of his principal officers, who had attempted to establish an independent authority. In this expedition he marched three thousand miles, through a country abounding with thick forests, rugged mountains, deep rivers, thinly inhabited, and almost wholly uncultivated. He was engaged in this dreadful service above two years; and though it was not distinguished by any splendid event, he displayed during the course of it, greater personal courage, more fortitude of mind, more patience and perseverance, than in any other period or scene of his life.

Finding himself exceedingly uncomfortable in Mexico, he returned to Spain to seek the redress of his grievances. The fame of new adventurers had now engaged the public attention, and Cortes died neglected, in the year 1547, in the sixty-second year of his age.

His character is thus drawn by Dr Robertson: "The turbulence of youth, as soon as he found objects and occupations suited to his mind, gradually subsided and settled in a habit of regular, indefatigable activity. The impetuosity of his temper, when he came to act with his equals, insensibly abated, by being kept under restraint, and mellowed into a cordial, soldierly frankness. These qualities were accompanied with calm prudence in concerting his schemes, with persevering vigour in executing them, and with what is peculiar to superior genius, the art of gaining the confidence and governing the minds of men. To all which were added, the inferior accomplishments that strike the vulgar, and command their respect; a graceful person, a winning aspect, extraordinary address in martial exercises, and a constitution of such vigour as to be capable of enduring any fatigue." (*v*)

CORTESIA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 177.

CORTONA, a town of Italy, is finely situated on the side of a mountain, about 30 miles south-east of Sienna. It is supposed to be the most ancient town in the country, and still retains its original name. The principal public buildings are seven churches, a museum, a public library, an academy, and twelve convents for both sexes. Some of the churches are handsome, and contain many valuable paintings. The object of the academy, which has obtained great reputation, is to discover and elucidate Etrurian antiquities. The ancient walls of Cortona were built of large blocks of stone without cement, and several remnants of them are still in great preservation. See Eustace's *Classical Tour through Italy*, vol. ii. p. 190. (π)

CORTUSA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 136.

CORUNNA, a sea-port town of Spain, in the province of Galicia. It is situated on a peninsula at the entrance of the bay, which stretches into the land as far as Betanzos. Corunna is divided into the upper and lower, or the new and old town. The old town, which is called *Pecaria* and *Pescaria*, is situated upon a tongue of land, which is surrounded by the sea almost up to the high town. The new town, which is situated on the declivity of a mountain, is inclosed by walls, and defended by a citadel. Its streets are narrower and worse paved than those of the old town.

The principal public buildings are St James's and St Mary's churches in the old town, and St Nicholas's and St George's in the new town; four convents, six chapels, one hospital for sailors, and another for the town's people. Besides these, there are artillery and naval schools, an arsenal, a storehouse for ammunition, an armoury, a powder magazine, and an aqueduct. There are also three squares in Corunna. The ancient tower is particularly deserving of notice, both from its height, and from the strength and solidity of its walls.

The harbour of Corunna, which is excellent, is in the form of a crescent, and has a handsome and convenient quay, which extends the length of the anchorage. It is sheltered from the north wind by a small island, and is defended by the forts St Claire and St Martins. The forts St Amaro and St Antonio defend the entrance to the harbour. The latter of these, which serves for a state prison, is placed upon a steep rock, and commands the harbour and the bay. The principal manufactories in Corunna, are of calicoes, table linen, hats, lace, combs, and ropes. The hat manufactory employed 150 people, who made about 20,000 hats annually for the interior of Spain. The rope walk employs 70 workmen, and cables are made from 120 to 160 fathoms. The commerce of Corunna is considerable. A light-house is erected on a lofty mountain about a league from the harbour. Population 4000. West Long. 8°, North Lat. 43° 23′. (π)

CORVUS. See Ornithology.

CORYCIUM, a genus of plants of the class Gynandria, and order Monandria. See Botany, p. 313.

CORYDALIS, a genus of plants of the class Diadelphia, and order Hexandria. See Botany, p. 285.

CORYLUS, a genus of plants of the class Monœcia, and order Polyandria. See Botany, p. 327.

CORYMBIUM, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 133.

CORYNOCARPUS, a genus of plants of the class Pentandria, and order Monogynia. See Botany, page 153.

CORYPHA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 184.

CORYSANTHES, a genus of plants of the class Gynandria, and order Monogynia. See Botany, p. 318, and Brown's *Prodromus Plant. Nov. Holl. et Ins. Van Diemen*, p. 378.

COS. See Stanchio.

COSENZA, a city of Italy, in the kingdom of Naples, and the principal town of Calabria Citra. It is situated near the southern extremity of a spacious plain, upon seven hills, at the distance of about twelve miles from the Tuscan Sea; and is surrounded by several villages called Casalis. The extent of the town is nearly three miles: the streets are in general straight, and the houses ill built, and there is only one of the streets that is distinguished by handsome edifices. The castle is finely situated on an eminence above the confluence of the rivers Busiento and Crathis, over which there are bridges. The cathedral, or metropolitan church, is a large massy and venerable edifice, and is the only church within the walls. In a church at the side of the castle there are two or three paintings, which appear to be of the school of Raphael. The three hundred and thirty-six casalis which encircle Cosenza contribute greatly to embellish the town, particularly on the south. They originated in the tenth century, about the year 975, when the Saracens took and destroyed Cosenza. The inhabitants who remained sought for refuge among the mountains, and the casalis gradually increased to their present size. Cosenza is also embellished by the junction of the Crathis and the Busiento, which is unfortunately the cause of the bad air that is often so injurious to the inhabitants, from the marshes left by the inundation of the adjacent grounds. There are almost no objects of antiquity at Cosenza. M. Bartels sought in vain for the place where Alaric, the chief of the Visigoths, was buried in 422. It is said that the Goths, by means of their prisoners, turned the course of the Busiento at its junction with the Crathis, and that they interred their king, with all his treasures, in the bed of the river; and in order that the place might never be discovered, they slew all the prisoners who were employed, and conducted the river into its former bed. M. Bartels found some columns which appeared to be the remains of an ancient temple. A small Hercules in bronze, and a Greek medal, were the only other antiquities which he saw. The royal tribunal, which sits at Cosenza, brings to the town a number of persons who have causes to decide, besides the governor, the assessors of the tribunal, and a crowd of advocates. The annual fair which is held here, and which had its origin in the time of Frederick II. is also of great advantage to the town, as it attracts numbers of people from the surrounding provinces. The earthen ware which is made in this place, forms its principal branch of industry. A number of small articles of iron, particularly knives, are likewise manufactured here. The people are nevertheless very poor and discontented. The adjacent country is beautiful and well cultivated, and produces abundance of corn, fruit, wine, oil, and silk. The grand forest of Sila, which covers a surface of 400 miles, commences near Cosenza, and extends almost to Catanzaro in Calabria Ultra. There are mines of salt in the neighbourhood of Cosenza, but they are not wrought, lest they should interfere with the manufacture of sea salt at Naples. Cosenza appears at first to be very populous, but this deception arises from the great number of the inhabitants of the casalis, who daily flock to the town. Swinburne estimates the population so low as 9000; but M. Bartels, who has visited the town more recently, computes the population at 15 or 16,000. East Long. 16° 22′, North Lat. 39° 22′. See Swinburne's *Travels*, and Bartels' *Voyage dans la Calabrie et la Sicile*. (π)

COSMEA, a genus of plants of the class Syngenesia, and order Polygamia Frustranea. See BOTANY, p. 308.

COSMELIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 174, and R. Brown's *Prodromus Plant. Nov. Holl. &c.* p 553.

COSMIBUENA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 176.

COSMOGONY, means an account of the creation of the world. Various cosmogonies are detailed by different authors. Moses's is unquestionably the most ancient; and had it no other circumstance to recommend it, its superior antiquity alone would give it a just claim to our attention. It is evidently Moses's intention to give a history of man, and of religion, and an account of creation. In the way in which he has detailed it, it would have been foreign to his plan, had it not been necessary to obviate that most ancient and most natural species of idolatry, the worship of the heavenly bodies. His first care, therefore, is to affirm decidedly, that God created the heavens and the earth; and then he proceeds to mention the order in which the various objects of creation were called into existence. First of all, the materials, of which the future universe was to be composed, were created. These were jumbled together in one indigested mass, which the ancients called chaos, and which they conceived to be eternal; but which Moses affirms to have been created by the power of God. The materials of the chaos were either held in solution by the waters, or floated in them, or were sunk under them; and they were reduced into form, by the spirit of God moving upon the face of the waters. Light was the first distinct object of creation; fishes were the first living things; man was last in the order of creation.

We deem it unnecessary to enter into a more minute detail on a subject, which must be familiar to all our readers; and we should reckon it presumptuous to amuse them with theories, where every thing is recorded as a matter of fact, and where the modes and order of creation, are ascribed to the will of the Deity, as their immediate cause. The account given by Moses is distinguished by its simplicity. That it involves difficulties which our faculties cannot comprehend, is only what might be expected, from a detail of the operations of the omnipotent mind, which can never be fully understood but by the being who planned them.

Most of the writers who come nearest to Moses in point of antiquity, have favoured the world with cosmogonies; and there is a wonderful coincidence in some leading particulars between their accounts and his. They have all his chaos; and they all state water to have been the prevailing principle, before the arrangement of the universe began. The systems became gradually more complicated, as the writers receded farther from the age of primitive tradition; and they increased in absurdity, in proportion to the degree of philosophy which was applied to the subject. The problem of creation has been said to be, "Matter and motion given to form a world;" and the presumption of man has often led him to attempt the solution of this intricate problem. At first, the cosmogonists contented themselves with reasoning on the traditional or historical accounts they had received; but it is irksome to be shackled by authority; and after they had acquired a smattering of knowledge, they began to think that they could point out a much better way of forming the world, than that which had been transmitted to them by the consenting voice of antiquity. Epicurus was most distinguished in this hopeful work of reformation; and produced a cosmogony on the principle of a fortuitous concourse of atoms, whose extravagant absurdity has hitherto preserved it from oblivion. From his day to the present, the world has been annoyed with *systems of creation*, which are at present swallowed up by the geological theories of chemists and mineralogists, whose speculations, in so far as they proceed on the principle of induction, have sometimes been attended with useful results; but when applied to solve the problem of creation, will serve, like the systems of their forerunners, to demonstrate the ignorance and the presumption of man.

The early cosmogonies are chiefly interesting from their resemblance to that of Moses; which proves that they have either been derived from him, or from some ancient prevailing tradition respecting the true history of creation.

The most ancient author next to Moses, of whose writings any fragments remain, is Sanchoniatho the Phenician. His writings were translated by Philo Byblius; and portions of this version are preserved by Eusebius. These writings come to us rather in an apocryphal form; they contain, however, no internal evidence which can describe their authenticity: they pretty nearly resemble the traditions of the Greeks, and are, perhaps, the parent stock from which these traditions are derived. Sanchoniatho, according to the most accurate chronology, was about 300 years later than Moses; and he professes to collect the opinions, traditions, and histories of the Phenicians respecting the cosmogony, and the first ages of the world. According to these accounts, chaos, and a spirit, or air, were the origin of all things. Φοινικων θεολογια την των όλων αρχην υποτιθεται αερα ζοφωδη και πνευματωδη, η πνοην αερος ζοφωδους, και χαος θολερον, ερεβωδες. He then proceeds to describe the manner in which creation commenced. The spirit fell in love with its own principles; in consequence of which there was a commixtion; and the new combination was called ποθος, Desire or Cupid. Having thus obtained a kind of tangible agent, who has great efficiency in all the systems of ancient mythology, the work of creation proceeded with great ease and expedition. We do not pretend to understand this; we only profess to translate; and our learned readers may ascertain the accuracy of our comment, by comparing it with the original; *οτε δε ηρασθη το πνευμα των ιδιων αρχων και εγενετο συγκρασις, ἡ πλοκη εκεινη εκληθη ποθος, αὑτη δε αρχη κτισεος απαντων.* As far as this system can be understood, it appears to be atheistical, at least its object seems to be, to show that the gods, as well as every thing else, had a beginning from some necessity of nature. In this respect it is directly, and in all probability, purposely opposed to that of Moses; in other respects, there is a striking resemblance, and it seems to have been copied from the Hebrew prophet, with such modifications as suited the pagan notions of the author. We have, however, a dark chaos, and a spirit, which, by a certain operation, affected this mass, and gave birth to creation. It would be needless to point out the resemblance between this idea, and that which is expressed in the second verse of the first chapter of Genesis. "*The earth was without form and void, and darkness was upon the face of the deep; and the spirit of God moved upon the face of the waters.*" The nonsense which is spoken about *ποθος* or Desire being produced by some mysterious agency of the spirit, has, in all probability, arisen from the Hebrew word translated *moved* in the verse now quoted; and which strictly signifies the affectionate fluttering of a bird over its young; or the incubation of a pigeon on its eggs: and hence also, the origin of the *mundane egg*, which makes such a conspicuous figure in various cosmogonies.

The notions detailed by Sanchoniatho are almost translated by Hesiod, *in Theogon.* who mentions the primeval chaos, and states *ερος* or Love to be its first offspring.

Anaxagoras was the first among the Greeks who entertained tolerably accurate notions on the subject of creation: he assumed the agency of an intelligent mind in the arrangement of the chaotic materials. *παντα χρηματα ην ὁμου πεφυρμενα ὁ νους δε αυτα διηρε και διεκοσμησε, και εκ της ατοξιας ες ταξιν ηγαγε.* These sentiments gradually prevailed among the Greeks; from whom they passed to the Romans, and were generally adopted, notwithstanding the efforts which were made to establish the doctrines of Epicurus by the nervous poetry of Lucretius. Ovid has collected the orthodox doctrines which prevailed on the subject, both among Greeks and Romans; and has expressed them with uncommon elegance and perspicuity in the first chapter of his Metamorphoses. There is the most striking coincidence between his account and that of Moses: one would almost think that he was translating from the first chapter of Genesis; and there can be no doubt that the Mosaic writings were well known at that time, both among the Greeks and Romans. Megasthenes, who lived in the time of Seleucus Nicator, affirms, that all the doctrines of the Greeks respecting the creation, and the constitution of nature, were current among the Bramins in India, and the Jews in Syria. *Clemens. Alex. Strom.* l. i. He must, of course, have been acquainted with the writings of the latter, before he could make the comparison. Juvenal talks of the writings of Moses as well known.

Tradidit arcano quodcunque volumine Moses.

We are therefore inclined to think that Ovid actually copied from the Bible; for he adopts the very order detailed by Moses. We call the attention of our readers to this curious subject. Moses mentions the works of creation in the following order; the separation of the sea from the dry land—the creation of the heavenly bodies—of marine animals—of fowls and land animals—of man. Observe now the order of the Roman poet.

Ante mare et terras, et quod tegit omnia cœlum
Unus era toto naturæ vultus in orbe,
Quem dixere chaos, rudis, indigestaque moles.—
Hanc Deus, et melior litem natura diremit.
Nam cœlo terras, et terras abscidit undis;
Et liquidum spisso secrevit ab aere cœlum.—
Neu regio foret ulla suis animalibus orba,
Astra tenent cœleste solum, formæque deorum;
Cesserunt nitidis habitandæ piscibus undæ:
Terra feras cepit, volucres agitabilis aer.
Sanctius his animal, mentisque capacius altæ
Deerat adhuc, et quod dominari in cætera posset:
Natus homo est.

Here we see all the principal objects of creation mentioned exactly in the same order which Moses had assigned to them in his writings: and when we consider what follows; the war of the giants; the general corruption of the world; the universal deluge; the preservation of Deucalion and Pyrrha; their sacrifice to the gods on leaving the vessel in which they had been preserved; there can scarcely remain a doubt that Ovid borrowed, either directly or at second hand, from Moses. What he says too, is perfectly consistent with the received notions on the subject, though it is probable that they had never before been so regularly methodised. This train of reasoning would lead us to conclude that Ovid, and indeed the whole heathen world, derived their notions respecting the creation, and the early history of mankind, from the sacred scriptures; and it shows how deficient their own resources were, when the pride of philosophy was forced to borrow from those whom it affected to despise.

With regard to the Western mythologists, then, there can be little doubt that their cosmogonies, at least such of them as profess to be historical, and not theoretical, are derived from Moses: and the same may be affirmed with regard to the traditions of the East; as they were the same with those of Greece, in the time of Megasthenes, whose testimony to this effect is quoted both by *Clemens Alex.* and *Strabo*, l. xv. we may naturally conclude that they had the same origin. The Hindoo mythology has grown, in the natural uninterrupted progress of corruption, to such monstrous and complicated absurdity, that in many cases it stands unique in extravagance. In the more ancient Hindoo writings, however, many sublime sentiments occur; and in the *Institutes of Menu*, many passages are found relating to the creation, which bear a strong resemblance to the account given by Moses. A writer in the Asiatic researches has been at the pains to collect these passages; and, deceived by the imagined antiquity of the work, he takes leave of the subject in a very extraordinary manner, by saying, that it is not his business to decide whether the Hindoos borrowed from Moses, or Moses from the Hindoos. There is yet another alternative: it is evident that the history of creation could only be communicated by revelation from heaven; for no man was present to see it; but it may justly be doubted whether Moses was the only person to whom this revelation was imparted. There is every reason to suppose that Adam, and all the antediluvian and postdiluvian patriarchs, had the knowledge of this event, acquired either by inspiration, or tradition, which they would naturally communicate to their families and dependents, and thus diffuse it over the face of the earth: and whilst Moses gave a correct and true account under the guidance of inspiration; others, receiving their information, through the uncertain channel of tradition, might give accounts bearing various shades of resemblance to the truth. (See ANTEDILUVIANS.) We are not under the necessity then, of supposing that even the heathen have borrowed from Moses when their accounts approximate the truth; except when the resemblance is so striking that it cannot be accidental; though there is every reason to think that they have borrowed much more frequently than is generally supposed.

The writer alluded to above was cured of his scepticism, so far at least as to confess that he had been deceived as to the great antiquity of the Indian record, on which he had laid so much stress as to set it in this respect on a footing of equality with the Bible. The passages relating to the creation, however, are curious; and the work from which they are taken is unquestionably ancient: they exhibit striking features of the Mosaic account, blended with the refinements of metaphysical philosophy. They are thus given in an advertisement, prefixed to the fifth volume of the Asiatic Researches, and are intended as a supplement to a former treatise on the Hindoo religion.

"This universe existed only in the first divine idea, yet unexpanded, as if involved in darkness, imperceptible, undefinable, undiscoverable by reason, and undiscovered by revelation, as if it were wholly immersed in sleep. (ch. i. 5.)

"When the sole self-existing power, himself undiscerned, but making this world discernible, with five elements and other principles of nature, appeared with undiminished glory, expanding his idea, or dispelling the gloom. (ib. 6.)

"He, whom the mind alone can perceive, whose essence eludes the external organs, who has no visible parts, who exists from eternity, even he, the soul of all beings, whom no being can comprehend, shone forth in person. (ib. 7.)

"He, having willed to produce various beings from his own divine substance, first with a thought created the waters. (ib. 8.)

"The waters are called *nara,* because they are the production of Nara, *or the spirit of God*; and since they were his first *ayana, or place of motion,* he thence is called Narayana, or *moving on the waters.*

"From *that which is,* the first cause, not the object of sense, existing every where in substance, not existing to our perception, without beginning or end, was produced the divine male. (ib. 11.)

"He framed the heaven above, and the earth beneath: in the midst he placed the subtile ether, the eight regions, and the permanent receptacle of waters. (ib. 13.)

"He framed all creatures. (ib. 16.)

"He too first assigned to all creatures distinct names, distinct acts, and distinct occupations. (ib. 21.)

"He gave being to time, and the divisions of time, to the stars also and the planets, to rivers, oceans, and mountains; to level plains, and uneven vallies. (ib. 24.)

"For the sake of distinguishing actions, he made a total difference between right and wrong. (ib. 26.)

"Having divided his own substance, the mighty power became half male, half female. (ib. 32.)

"He whose powers are incomprehensible having created this universe, was again absorbed in the spirit, *changing the time of energy for the time of repose.*" (ib. 56.)

In these passages, we have evidently a philosophical comment on the account of creation as given by Moses; or as transmitted from one generation to another by oral tradition: and it would not detract in the least degree from the credit of Moses, were we even to suppose the Hindoo account to be more ancient than his; of which, however, there is not the shadow of probability.

We also see in these passages the rudiments of the Platonic philosophy, *the eternal ideas in the Divine mind,* &c.; and were any question to arise respecting the original author of these notions, we should have little hesitation in giving it against the Greeks. They were the greatest plagiaries both in literature and philosophy, and they have scarcely an article of literary property which they can call their own, except their poetry. Their sages penetrated into Egypt and India, and on their return stigmatised the natives of these countries as barbarians, lest they should be suspected of stealing their inventions. The same principle led both Egyptians and Indians to conceal the source from which they derived their knowledge, and to appropriate to themselves all the information which they had gleaned by their intercourse with more enlightened people. Hence the extravagant pretensions of both these nations to antiquity, both as to their literary productions and their political establishments; pretensions which now shrink into very limited dimensions, and excite the derision rather than the wonder of the learned.

After the account which has been given of the principal systems of cosmogony, and of their respective merits, it will not be necessary to dwell long on those which are formed on similar principles. The Chaldean cosmogony, according to Berosus, in his *Babylonica,* as preserved by Syncellus, when divested of allegory, seems to resolve itself into this, that darkness and water existed from eternity; that Belus divided the humid mass, and gave birth to creation; that the human mind is an emanation from the divine nature.

The cosmogony of the Persians is very clumsy in its structure. They introduce two eternal principles, the one good, called Oromasdes, the other evil, called Arimanius; and they make these two principles contend with each other in the creation and government of the world. Each has his province, which he strives to enlarge, and Mithras is the mediator to moderate their contentions. This is the most inartificial plan that has been devised to account for the existence of evil, and has the least pretensions to a philosophical basis.

The Egyptian cosmogony, according to the account given of it by Plutarch, seems to bear a strong resemblance to the Phenician, as detailed by Sanchoniatho. According to the Egyptian account, there was an eternal chaos, and an eternal spirit united with it, whose agency at last arranged the discordant materials, and produced the visible system of the universe.

The cosmogony of the northern nations, as may be collected from the Edda, supposes an eternal principle prior to the formation of the world.

The Orphic Fragments state every thing to have existed in God, and to proceed from him. The notion implied in this maxim is suspected to be Pantheistic, that is, to hold the universe to be God.

Plato supposed the world to be produced by the Deity, uniting eternal immutable *ideas*, or *forms*, to variable matter.

Aristotle had no cosmogony, because he supposed the world to be without beginning and without end.

According to the Stoical doctrine, the divine nature acting on matter, first produced moisture, and then the other elements, which are reciprocally convertible. See Shuckford's *Connections*; Grotius *De Veritat. Relig. Christ.* l. 1.; Enfield's *History of Philosophy*; and the books already mentioned in this article. (*g*)

COSSACKS, or KOZAKS, a military nation inhabiting the frontiers of the Russian empire, and constituting its principal defence against the incursions of the Tartars and other savage tribes.

Origin and history.

The origin of this people has never been completely ascertained. Some maintain that they are of Polish extraction, and that their language is a dialect of the Polonese;* while others trace their emigration from the country of Casachia, a part of the modern Circassia, lying in the vicinity of Mount Caucasus. This country is distinctly mentioned by Constantine Porphyrogenetes, and it is from hence that they are said to have derived their name.† Their history, as given by themselves, fixes their origin to be a mixture of Circassians and Greeks, afterwards augmented by strangers from various nations. According to their own account, their capital was founded by refugees from Greece, who, having been denied admission by the people of Azof, proceeded up the river, and established a new settlement, to which they gave the name of Tcherchaskoy, implying "the small village of the Tcherchas," or according to our orthography, Circassians, on whose frontier it was situated, and by whom its population was soon increased. This colony was the original stem, from which has sprung these innumerable hordes, which have now penetrated into almost every division of the Russian empire. The circumstance which has led to the erroneous notion that they are of Polish origin is thus given by Dr Clarke. "Those of the Don relate, that a party of Cossacks being engaged in their usual occupation of hunting, near the range of Mount Caucasus, met a number of people, with whom they were unacquainted, going towards the East; and having enquired who they were, the strangers answered, that they were emigrants from Poland, who had fled the oppression of their nobles, and were proceeding to Persia, to join the troops of that country against the Turks. The Cossacks told them that they might spare themselves the trouble of so long a march in order to commit hostilities upon the Turks, and persuaded them to return with them to the town of Tcherchaskoy, where they would find an asylum, and whence, in concert with them, they might attack the fortress of Azof. Assisted by this reinforcement, and with only four pieces of cannon, all the artillery they possessed at that time, they laid siege to Azof, which fell into the hands of the combined forces." This was their first appearance as a warlike nation; and to their success in this enterprize, must be attributed that fondness for war, by which they have been since so greatly distinguished. About the middle of the tenth century, they were employed as mercenaries by the Greek emperor in his war against the Turks; and in consideration of their important services, he sent them with assurances of protection and recommendatory letters to the king of Poland. They had early begun an intercourse with the people of that country, and the frequent emigrations of the Poles had added to their number and their strength. It was indeed a law in their constitution, that whosoever chose to settle among them, even their prisoners of war, were admitted into all the privileges of citizenship. Russians, Poles, Tartars, Circassians, Calmucks, Armenians, Greeks, and Turks, were received without distinction; and thus the Cossack nation may be considered as a mixture of various tribes, united by a similarity of disposition, and forming, by reason of their government and manners, a distinct class in society. They were first employed in the Russian armies in 1579; and, after the demolition of the Tartarian empire, were appointed by the Russian government the guardians of the new frontiers. They had certain lands allotted to them for their support, and obtained a constitution, which included various privileges unknown to the other subjects of the Russian empire. Their numbers, however, so rapidly increased, that they have been compelled to seek for other settlements; and their colonies extend from the banks of the Dnieper to the remotest confines of Siberia. The Cossacks are in modern times known under various appellations, but of these the Don Cossacks may be regarded as the principal stock; and it is to them that we intend chiefly to confine the present article, contenting ourselves with a brief account of its different branches.

Soil and agriculture.

The country of the Don Cossacks is bounded by the governments of Saratof, Caucasus, Voronetz, and Ekaterinoslaf; and is upwards of 3600 square miles in extent. The soil is in general rich and fruitful, and well adapted for agriculture or pasture. The immense *steppes* which lie between the Don and the Danaetz, present, in summer, one wild continued meadow, full of flowers, and producing the richest herbage. But many of these plains are desolate and untenanted, except by beasts of prey. Cultivation is unpardonably neglected; the grass is allowed to rot upon the ground, and the only appearance of culture is confined to the banks of the rivers. The indolence and unsettled military life of the Cossacks, indeed, preclude all hope that they will ever take advantage of their fine situation, and apply themselves to the labours of husbandry. The want of towns, where they might convert their produce into money, is also another very considerable obstacle to every kind of agricultural improvement. Many of them have farms on which they maintain from 50 to 200 horses, as many horned cattle, and several hundred sheep. But the principal branch of husbandry among the more wealthy, is the cultivation of the vine. This, however, is attended with some difficulty, as the vines must be buried during the winter, to protect them from the frost, and dug up in the spring. The vineyards are chiefly planted on the southern declivity of the heights and banks of the Don, in a marly and calcareous soil; and the grapes arrive very early at maturity. The wine that is produced from them is sometimes uncommonly good, resembling something between Burgundy and Champagne, but in general it is very poor and tasteless.

* Scherer *Tableau de la Petite Russie*, tom. 1.

† Peyssonnel *Observations Historiques, &c. sur les Peuples Barbares*, p. 125. Their name has given rise to many absurd etymologies. Some derive it from a Tartar word signifying *an armed man*; others from a Polish word *Cosa*, implying a goat, either from their nimbleness, or because they formerly wore the skins of that animal; others from *Kossa*, a small promontory; and others from a word signifying a *Rover*; but the most probable is that of Peyssonnel, given in the text.

Cossacks. It is both white and red; and "if they would suffer the grapes to ripen," says Dr Clarke, "and knew the best art of preparing it, it would certainly surpass all the wines in the world, so rich and generous are the grapes affording it." For several miles round Tcherchaskoy, there are many excellent orchards, well stocked with apples, pears, peaches, plums, &c.; and in their gardens they raise melons, cucumbers, and all kinds of kitchen stuffs. Most of the towns and villages are built upon the edge of the rivers, below the level of the plain, and are so concealed by the banks, that a stranger crossing the country might suppose himself in a desert, and yet be in the midst of habitations.

Rivers. The principal of these rivers are the Don, Danaetz, Choper, Medveditz, Havla, Bouzoulook, Sal, and Manhytch. Don. The Don, according to Dr Clarke, resembles the Nile in almost all its characteristics. It has the same regular annual inundation, the same aquatic plants, the same tall flags, reeds, and bulrushes, sometimes rising to the height of twenty feet; and falls into the sea by a plurality of mouths, forming several small islands, as in the Delta, filled with fens and morasses. It rises in the government of Rezan, near Tula, from the Ivan Ozevo Lake, or St John's Sea, and after a course of about 660 miles, falls into the Sea of Azof. Its bed is generally formed of sand, marl, and lime, without either rocks or stones of any size; and during the inundations, from the middle of April to the end of June, it is of sufficient depth for ships of burden as high as Woronetz; but during the rest of the year it is so low, that upon several of the shallows the water is scarcely eighteen inches deep. The Donetz, or more Danaetz. properly the Danaetz, takes its rise in the government of Kursk, and is navigable as far as the Isum. It falls into the Don about forty-six miles above Tcherchaskoy, and receives the name of the Northern Danaetz, to distinguish it from one of the arms of the Don which takes a north-westerly direction a few miles below the fortress of Rastof, and which is called the Dead Danaetz; from a supposition that has existed from time immemorial, that the Danaetz, at this place, separates itself again from the Don. From this circumstance, Dr Clarke is of opinion, that the Tanais of the Greeks is the same as the Danaetz of the Cossacks, the change from D to T being a very common modification in language; and that the Greeks, when steering along the shore from the Crimea, having first entered into this arm of the Don, gave the name of it to the whole river. The banks of these rivers are in many places finely wooded with forests of pines and oaks, and the rivers themselves abound with plenty of excellent fish, in the greatest variety and perfection. Among these, the principal is the *beluga*, the largest eatable fish known. It resembles a sturgeon in shape, and has been seen fifty-six feet long, and eighteen feet thick, though in the Don it seldom exceeds twelve feet in length. There are also sturgeon, sterlet, trout, rudak, Prussia carp, tench, pike, perch, water-tortoises, and craw-fish of an enormous size, sometimes indeed as large as our lobsters.

Quadrupeds. The immense steppes of the Don are inhabited by innumerable animals. Besides the wolf and the bear, is the *biroke*, which is of a grey colour, with a long full tail hanging to the ground. It is about the size of a wolf, and has some resemblance to that animal; but is so ferocious that it will attack a man. It is hunted by the Cossack peasants, armed with lances, and on horseback. But the most numerous class of quadrupeds in these plains is of a smaller race, of which the most remarkable are the *suroke* and *sustic*. The former is the arctomys bobac of zoologists, and is about the size of a large badger, of a greyish-brown colour. Its head, teeth, and mouth, are like those of a squirrel, but its eyes are round, dark, and bright, and its ears rather shorter. It has a large protuberant belly, a short tail, and its paws resemble very much the hands of a man. It burrows in the earth with amazing rapidity, where it remains in a state of torpor during the half of the year; and, in general, makes such extensive subterraneous chambers, that the land is destroyed wherever it is found. Its voice resembles the grunting noise of a guinea-pig; and, when pleased or frightened, it utters short and loud squeaks like a person whistling. Many of these animals are kept tame in the houses of the peasants, but they invariably retire to their burrows in September, and never appear again until about the beginning of April. The *sustic* is a much smaller animal, and is supposed to be the *mus citillus* of Buffon. It, however, resembles the suroke in many of its habits. It makes the same whistling noise, and burrows in the earth with great quickness; but it is not supposed to sleep the half of the year, as it collects a hoard of provisions for the winter. It is a beautiful little creature, about the size of a weazel, and its colour is thus described by Dr Clarke: "All the upper part of its body is of a deep yellow, spotted with white. Its neck is beautifully white; the breast yellowish, and the belly a mixed colour of yellow and grey: it has, moreover, a black forehead, reddish-white temples, and a white chin. The rest of its head is of an ash-coloured yellow; and the ears are remarkably small." Sustics are a favourite food of the Calmucks, but are seldom eaten by the Cossacks; and are found in such swarms near the Don, that they may be taken in almost any number. Among the birds of these steppes may be mentioned those called Birds. *staritchi*, or elders, which are about the size of a snipe, of a brown colour, and very elegant form, and are held by the Cossacks in superstitious veneration.

Tumuli. Ancient sepulchral hillocks, or *tumuli*, are scattered all over the country; but they increase both in number and size towards the Don and the Sea of Azof. Some of them which have been opened by the Cossacks, were found to contain bones of men and horses, earthen vessels, and instruments of war common to ancient nations. Near the mouth of the Don, on the European side of the river, are a remarkable groupe of these tumuli, which from time immemorial have been known by the name of the *Five Brothers*. From their position and appearance, Dr Clarke supposes that they are the βωμοι, or altars either of Alexander or Cæsar, which were mentioned by Ptolemy in his *Geography*, lib. iii. c. 5. At a place called Zimlanskaia, on the Don, and about 200 miles above Tcherchaskoy, are said to exist the traces of a citadel built by Alexander the Great. The inhabitants have a tradition among them, that Alexander crossed the river at this place, and built a city or citadel. Dr Clarke saw two stelæ, or marble pillars, which had been brought from thence by General Orloff.

Government. Though the Don Cossacks are in complete subordination to the Russian government, they possess a constitution of their own, which is at once military and democratic, and which keeps them entirely distinct from the other subjects of the empire. Their territory is divided into 112 stanitzas, or cantons, which are disposed along the rivers in the following manner:

On the Don, including Tcherchaskoy, which contains eleven	62
On the Danaetz	9
On the Choper	20
On the Medveditz	11
On the Bouzoulook	10
Total	112

Each stanitza has a certain portion of land and fishery allotted to it by government, and an annual allowance of corn, according to the returned number of Cossacks. The distribution of the land among the inhabitants is settled by themselves with their Ataman; and every individual may either retain his proportion in his own possession, or let it out to farm. The Ataman, or Hetman, is both the civil and military commander of the place, and is annually chosen by the people. He used formerly, when the Cossacks were called upon actual service, to march at the head of his stanitza; but now he merely furnishes the required contingent of troops, which is put under officers named by the crown. The respect that is paid to him is entirely temporary, and only when he is engaged in the execution of his duty. If he convened any of the inhabitants upon business, however trivial, Dr Clarke observed that they made their obeisance before him, standing bare-headed, as in the presence of a sovereign; but the moment the assembly was dissolved, he passed unheeded among them, receiving no other mark of respect than any of the other Cossacks. These Atamans are all subject to the Glavnoi Ataman, who is generalissimo of the armies of the Don; and an appeal from their decisions lies to the Chancery at Tcherchaskoy, which consists of the Glavnoi Ataman as president, and the officers of the regiments as a council. The Glavnoi Ataman was formerly elected by the other Atamans, and his authority was almost absolute; but he is now appointed by the crown, and greatly diminished in power The Cossacks are exempted from all taxes, even from those of salt and distillation; and for the levies, which are required by their internal constitution, they impose small contributions on themselves.

Military state.

But for their allowance and privileges, they are liable to be called out on military service in any part of the world for a term not exceeding three years, mounted, clothed, and armed at their own expence. They must consequently be at all times completely ready to march, and when on actual service, they receive pay as other Russian soldiers, and are furnished by government with food and camp equipage. Those who have served three years, are generally freed from foreign service, except upon particular emergencies; and are employed chiefly in the cordon along the Caucasus, or in the duties of the post and police. After twenty years, their service are required only in the duties of the police, or in assisting the corn-boats over the shallows of the Don; and after twenty-five years service, they are entitled to complete exemption. Their officers were formerly without rank, and might be placed under a subaltern in the army, but they have now rank in the army; and their *polki* or regiments are put on a more regular footing, being uniformly clothed and accoutred. The military duty of the Don Cossacks, considering the state of the Russian peasantry, is well repaid by their privileges and the freedom which they enjoy; and "free as a Cossack," is a common proverb among their fellow subjects. War, indeed, is their greatest pleasure, for then they live according to their inclinations, and sometimes enrich themselves with the spoils of the enemy; and as they are more employed in service than the other corps of Cossacks, they are consequently better soldiers.

Appearance.

They are in general well made, handsome, and taller than the Russians. "There is something extremely martial," says Dr Clarke, "and even intimidating, in the first appearance of a Cossack. His dignified and majestic look; his elevated brows and dark mustachoes; his tall helmet of black wool, terminated by a crimson sack, with its plume, laced festoons, and white cockade; his upright posture; the ease and elegance of his gait, give him an air of great importance."—"Their dresses were much richer than any thing we had seen in Russia, although all were uniform. Each person's habit consisted of a blue jacket, edged with gold, and lined with silk, fastened by hooks across the chest. Beneath the jacket appeared a silk waistcoat, the lower part of which was concealed by the sash. Large and long trowsers, either of the same material as the jacket, or of white dimity, kept remarkably clean, were fastened high above the waist, and covered their boots. The sabre is not worn, except on horseback, on a journey, or in war. In its place is substituted, a switch or cane, with an ivory head: this every Cossack bears in his hand as an appendage of his dress; being at all times prepared to mount his horse at a moment's notice. Their cap or helmet is the most beautiful part of the costume; because it is becoming to every set of features. It adds considerably to their height; and gives, with the addition of whiskers, a military air to the most insignificant figure. They wear their hair short round the head, but not thin upon the crown. It is generally dark, thick, and quite straight. The cap is covered by a very soft and shining black wool. Some of them have civil and military distinctions of habit; wearing in time of peace, instead of the jacket, a long frock without buttons. The sash is sometimes yellow, green, or red, though generally black; and they wear large military gloves. There is no nation in the world more neat with regard to dress; and whether young or old, it seems to become them all."—"We never saw a Cossack in a dirty suit of clothes," he afterwards adds; "their hands, moreover, are always clean, their hair free from vermin, their teeth white, and their skin has a healthy and cleanly appearance." When on active service, every Cossask must keep two horses, one for himself and the other for carrying provisions, &c. Their arms consist of a lance about twelve feet in length, with an iron head, and a small streamer attached to it; a brace of pistols, with a cartouch box; a sabre, without either guard or cross bar, and a whip, which hangs from the right wrist; and which, being made of plaited leather as thick as one's thumb, they sometimes use against a conquered enemy, as well as for stimulating their horses. Their horses are small, but strong and active, and admirably trained. Their saddle is merely a wooden frame, with a leather cushion upon it, and under it is laid a piece of felt to save the horse's back. They ride short and full-footed, raising themselves in their stirrups, and bending their bodies with great activity; and never push their horses on full speed in a straight line, but when galloping wheel continually in a serpentine direction to the right and left. Each regiment has two or more banners of silk, on which are painted a patron saint, arms, &c. but they have no martial music. When not in action, the lance is slung on the foot or on the pummel of the saddle; but when

Dress.

Accoutrements.

Cossacks. engaged, they put it under the arm, and direct it with great dexterity; when retreating, they rest it on the shoulder, opposing its point to the pursuing enemy. The Cossacks are well adapted for desultory warfare. They are very hardy, contented with scanty subsistence; and can take the field every day without intermission. They are encumbered neither with artillery, baggage, nor store-waggons. A piece of felt serves for their cloak, their tent, and their bed, and they feed their horses upon whatever they can find. They are seldom disciplined to attack in squadron, but act only as skirmishers, and are indefatigable in harassing the enemy. They particularly excel as patrols, are remarkable for their vigilance in outposts and their knowledge of the country; and from habit and practice they can discover the movements of the enemy far beyond the reach of usual observation, and by applying their ears to the ground, can distinguish the approach of an army at a very considerable distance. Indeed the Cossacks constitute the most useful and effective troops in the Russian armies; and, when let loose on a flying enemy, are most destructive. In the Austrian campaign of 1805, seventy-two regiments of 560 men each, under General Platof the Ataman of Tcherchaskoy, were ordered to join the armies, but they arrived too late for the battle of Austerlitz. There were present in that battle 600 Cossacks, who suffered dreadfully, as they were for some time the only cavalry with the Russian army; and, before the Emperor joined Kutusof, had lost almost all their horses with fatigue. In the campaign of last year (1812), however, they have been more successful, and greatly contributed to the destruction of the French army. See RUSSIA.

Women. The Cossack women are in general beautiful, but rather singular in their dress. Matrons wear an immense cap, resembling the mitre of a Greek bishop, bespangled with jewels, or covered with flowers, with the hair tucked under it; but girls have merely an Indian handkerchief wrapped round the head, with their hair plaited and hanging down the back. They all wear trowsers which reach to the ancles, and over them a silk or cotton tunic. In their domestic employment they go barefooted, but when in full dress they have slippers and stockings of yellow morocco. White linen is scarcely used, except among the poor, the shifts of the rich being commonly made of dyed cotton or Asiatic silkstuffs, either of a yellow or blue colour. Other parts of their dress that are seen, are generally of muslin.

Manners and customs. The Cossacks have been long considered by the other inhabitants of Europe as semi-barbarians, both in their manners and dispositions; and, indeed, they are still represented in that light by the Russians, who, envious of their privileges, attempt by every means to vilify and degrade them to strangers. Professor Pallas has even imbibed much of the Russian prejudice with regard to this people, and has given a very melancholy picture of the state of society in their capital. Mr Tooke also describes their countenance and character as entirely Russian, but rendered, by their education and course of life, only more bold and resolute than the Russian vulgar. Dr Clarke, however, has completely removed these aspersions, and has established their character as very superior indeed to any of the natives by whom they are surrounded. In his progress through their country, he met with the greatest attention and politeness. He travelled with greater security, and was less exposed to impositions and insult than ever he had experienced among the Russians. At the first stanitza which he visited, the Ataman gave up his own house entirely to his use, which was well stocked with provisions and luxuries of every kind; and when he offered some remuneration for the accommodation which he had received, he was told that "Cossacks do not sell their hospitality." He every where found a brave, lively, and hospitable people, was pleased with their appearance, and admired their independence. "Polished in their manners, instructed in their minds, hospitable, generous, disinterested, humane and tender to the poor, good husbands, good fathers, good wives, good mothers, virtuous daughters, valiant and dutiful sons; such," says he, "are the natives of Tcherchaskoy.* In conversation the Cossack is a gentleman; for he is well-informed, free from prejudice, open, sincere, and honourable."—"The manners of the people," says Mr Heber, "struck us, from their superiority to the Russians, in honesty and dignity. A lieutenant at Petersburgh, once begged alms from us, bowed himself to the ground, and knocked his head on the floor. A lieutenant here, (Tcherchaskoy), who was imprisoned, and also begged, made the request in a manly and dignified manner, and thanked us as if we had been his comrades. They are, however, indolent, and fond of pleasure; violent when irritated, and vehement in their amusements. Some of them live in great affluence, and enjoy the refinements and luxuries of the most polished and civilized nations. The custom of drinking toasts, and of rising to pledge the security of the cup-bearer, as also the more ancient one of bowing and congratulating any one who happens to sneeze, are very prevalent among this people; and though the poorer classes have plenty of excellent food, and as much brandy as they can drink, yet the greatest order and harmony are maintained in their stanitzas. In Tcherchaskoy, the inhabitants are very gay and social. They have frequent balls and parties of pleasure; and they had once a theatre, but it is now prohibited. The Cossack dance resembles very much the English hornpipe, but it is accompanied by whistling, and by short and sudden shrieks. They move the head from one shoulder to the other, while the

* Professor Pallas, who spent only one day at Tcherchaskoy, has given us a very different account of its inhabitants. "I cannot speak favourably," says he, "of the moral character of its inhabitants, whether male or female. A continual habit of good living, indolence, and debauchery, the natural consequences of the superfluity which the excellent possessions of this free militia afford, have thoroughly corrupted their manners, and their ancient simplicity has been almost entirely superseded by luxury. Here, as in other countries, the capital is the seat of corruption, which gradually infects the mass of the people The distinctions and privileges, which have in later times been too liberally granted to the higher ranks, have rendered these, as well as the people, proud and insolent. The former, who have established villages on the beautiful tracts of land granted to them on the eastern bank of the Don, and encouraged vagrants to settle there, endeavour to oppress the poorer class of inhabitants, by imposing upon them all the burthens of military duty; though they spare the more wealthy, whose common interest it is to deprive the latter frequently even of the payments due for their services. The discontent resulting from this conduct is construed by their superiors, into want of obedience and mutiny, so that it is productive of additional oppression. Thus a people naturally well disposed, and who have hitherto been very useful to Russia in furnishing the empire with light troops, are continually more injured in their free constitution, and daily shew greater aversion to military service; while their affluent governors live in the most voluptuous indolence and immorality." Pallas *Trav.* vol. i. p. 469.

Cossacks. hands are held up near the ears. This attitude, which, with the sudden shrieks, prevail very much among the lower orders of Scotland, is common to the dances of all the Tartars and Chinese. The Highland bag-pipe is much in use in this country, and is often accompanied by Calabrian puppets, which are so managed by the pipes as to move in time with the music. The Cossacks have a kind of solemn games, which consist entirely in martial exercises, such as riding, tilting, and hacking with the sabre. Upon such occasions, they are ambitious of shewing their dexterity, and always appear well mounted, and in their best attire. The arrival of the ammunition, which is annually sent hither by the crown, is always considered by them as a kind of festival day. It is met by all the stanitzas in parade, and received at Tcherchaskoy by the regiment of the place, with colours flying, and brought in grand procession to the arsenal.

Religion. The Cossacks are generally of the Greek religion, but neither so ignorant nor illiterate as they have been often represented, and their clergy are under the jurisdiction of the bishop of Woronetz. A ceremony, called "The Benediction of Bread," takes place in all their churches every Saturday evening. Five white loaves, symbols of those with which our Saviour fed the multitude, are placed in the middle of the church; and all the people pray that, "as with five loaves he fed the five thousand, he would vouchsafe a sufficiency of corn in the country for the bread of its inhabitants, and bless it for their use."

Mr Tooke represents them as totally negligent of all science and letters, but entirely addicted to war, having rendered themselves famous only as heroes and conquerors, and sometimes as rebels or tyrants—Yermak the conqueror of Siberia, and the impostor Pugatshef being both Cossacks of the Don. But though none of this nation have ever appeared among the literati of Europe, yet they are not to be considered on that account as destitute either of literary knowledge or abilities. In Tcherchaskoy there is a public academy, where are taught various languages, geometry, mechanics, physics, geography, history, arithmetic, &c. and where all the children of the officers are educated. Dr Clarke has paid a very high tribute to their literature and accomplishments in his character of Lieutenant-Colonel Papof. "To this officer," says he, "we were indebted for instances of hospitality and polite attention, such as strangers might rarely expect in more enlightened cities of Europe. His education had been liberal, although received in the marshes of the Don; and his accomplishments might have graced the most refined society, although derived from the natives of Tcherchaskoy."

Commerce. The commerce of the Cossacks is not considerable, being carried on chiefly with the Greeks and the inhabitants of Kuban, and consists in grain, iron, timber, sail-cloth, hemp, fish, caviare, horses, horned cattle, tallow, and butter. Their capital, Tcherchaskoy, however, was formerly a place of great commercial importance, where the productions of Russia and Turkey were reciprocally exchanged. It was also the emporium of an inland commerce between the merchants of Kuban and Crim Tartary, and the Russians. Its imports were chiefly Greek wines, raisins, dried figs, almonds, oil, rice, saffron, painted linens, and cottons; and its exports were hides and leather, coarse linen, hard-ware, caviare, &c. Plenty of timber is brought from the forests, which cover the banks of the Don and the rivulets which fall into it, and is floated down the stream to St Demetri and Rostof. The shops in the principal towns are generally well supplied with most articles of luxury, and nothing is wanting that can contribute to the comforts and conveniences of a civilized people.

Principal towns. The principal towns in the Don Cossack territory are Tcherchaskoy and Kasankaia, both upon the Don, and both of considerable size. The former contains about three thousand houses, and fifteen thousand inhabitants. Its buildings are chiefly of wood, and all raised from the ground on wooden piles; for when the river is flooded by the melting of the snows, the whole town, except a few principal places adjoining the cathedral, is so inundated, that many of the ground floors of the houses are completely under water. It formerly had walls, but they were swept entirely away; and during the inundations, the only communication which the inhabitants have with each other is by means of bridges or boats. The stanitzas, in general, have the appearance of badly fortified villages, and their population is very unequal. Each of them, however, has a church, some of them two, a court-house, an ataman, and other officers, with a few pieces of cannon. The churches are every where good, and indeed much superior to what we find in the villages of our own country, both as to architecture and interior decorations. The houses are mostly of wood, and are so constructed, that they may be removed entire from one place to another. They are much cleaner, and better furnished than those of the Russians; many of their rooms are handsomely fitted up with paper hangings, and ornamented with no mean paintings of saints, virgins, and bishops.

Population. The population of this territory has never been exactly ascertained, as the Cossacks will allow no examination into their numbers. It is conjectured, however, that there are about 200,000 Cossack inhabitants, of whom 25,000 are in arms; and they can at any time furnish above 50,000 cavalry completely equipped. There are also in this country 30,000 wandering Calmucks scattered over the *steppes*; and of these 5,000 bear arms, and are ready at all times for actual service.

The other denominations of Cossacks, besides those of the Don, are, the Malo-Russian Cossacks, the Tchernomorski, or Cossacks of the Black Sea, the Cossacks of the Volga, of Grebenskoy, of Orenbourg, of the Ural, and of Siberia, with other smaller branches.

Malo-Russian Cossacks. The Malo-Russian Cossacks had their origin much later than those of the Don; and, it would seem, assumed the name of Cossacks, or had it bestowed upon them merely from the nature of their government. They are supposed to have at first consisted of a multitude of fugitives from Poland and Russia, who, having settled in the lower regions of the Dnieper, which they called Malo, or Little Russia, adopted a military form of government, in order the better to maintain their independence. By degrees they spread themselves towards the south over the whole country, between the Dnieper and the Dniester; and were almost continually engaged in petty wars with the Tartars and Turks. They had even penetrated into the Crimea, captured Trebisond, and made military campaigns to Constantinople. They thus formed a barrier to the king of Poland on the side of Turkey, and their republic on that account was encouraged and protected by the Polish sovereigns, whose supremacy it acknowledged. But this protec-

Cossacks.

tion at last degenerated into oppression; and was followed by a rebellion of the Cossacks, who, after a tedious war, threw off their allegiance to Poland, and formally submitted themselves to the Tzar of Russia in 1654, about three hundred years after their first institution as a distinct government. Since that time, however, the form of their government has been greatly changed, and they now scarcely retain any vestiges of their ancient freedom. They are very numerous, but great numbers of them are registered only as Reserve Cossacks; and 30,000 only are kept in constant service and pay, and wear the hussar uniform and arms. From their manners and way of life, however, the Malo-Russians are still considered as a distinct people. In their features, in their amusements, in their love of mirth and drinking, and in the dress of their females, they resemble the Don Cossacks; but they are far superior to them in industry. They have converted many of their desolate steppes into rich fields of corn; and they rear an immense number of fat cattle, which are sent to Breslau, Petersburgh, &c. The overplus of their grain they partly export, and partly distil into brandy, of which they have always a prodigious quantity, both for sale and for their own consumption. "They are a more noble race," says Dr Clarke, "stouter, and better looking than the Russians, and superior to them in every thing that can exalt one class of men above another. They are cleaner, more industrious, more honest, more generous, more polite, more courageous, more hospitable, more truly pious, and, of course, less superstitious."

Cossacks of the Black Sea.

The TCHERNOMORSKI, or *Cossacks of the Black Sea*, inhabit the peninsula of Taman, and the country between the Kuban and the sea of Azof, as far as the rivers Ae and Laba, comprehending an extent of territory of above a thousand square miles. They are a branch of the Malo-Russian Cossacks, and their history is rather curious. Their original appellation was Zaporogztsi, from the place of their former residence, implying *beyond the cataracts* of the Dnieper; and they at first consisted only of a band of martial Malo-Russian youths, who were placed on the southern borders of that river, as a frontier defence against the inroads of the Tartars. Being all unmarried, and pleased with the freedom which they enjoyed, they continued in their dangerous posts, and were never desirous of being recalled. War and plunder were their habitual employment; and they were soon joined by others, who either wished to engage in military exercises, or sought a shelter among them from Polish oppression. Their numbers thus gradually increased, and at last became so considerable, that about the beginning of the seventeenth century, they separated from the parental stock, and erected a military state of their own. Their constitution was purely democratic. All were equally eligible to the sovereign dignity of Ataman, who was annually chosen by a plurality of voices, and who, upon the expiration of his office, was again numbered among the common Cossacks, and received no greater respect than the rest of his brethren. Their *setscha*, or chief residence, was at first situated on an island of the Dnieper, below the cataracts; but it was afterwards occasionally removed from one place to another. It consisted of a collection of huts, surrounded by a wooden fortification, and had a kind of fortress, which contained their artillery, arms, ammunition, and warlike stores. It was divided into 38 quarters, each of which had an ataman and other officers, who were, however, all subject to the chief ataman. In the market-place were exposed to sale provisions, clothes, and all kinds of necessaries, which were brought hither by foreign merchants, who took up their quarters in the suburbs. No women were admitted into the *setscha* upon any account whatever, and celibacy was most strictly enjoined upon every member of their society. But in order to keep up their numbers, they carried off children wherever they could find them; and welcomed and adopted fugitives from every nation, who were willing to conform themselves to their discipline and regulations. None were detained contrary to their inclinations. Every individual was at full liberty to depart when he pleased; and to be a Cossack was, in their opinion, too great an honour, to be forcibly conferred upon any one who was dissatisfied with their government, or way of life. The greater number of them lived in the setscha, but many of them dwelt also in a suburb adjoining it, or inhabited the small villages that were situated within their territories; and, in order to gratify the instincts of nature, they frequently carried off women from the Tartars and Poles, or got loose females from Little Russia, with whom they lived without any forms of marriage, but were obliged to keep them at a distance from the setscha. Though they subsisted almost entirely by rapine, yet, in proportion as bounds were set to their depredations, many of them engaged in traffic and the common trades, and others employed themselves in agriculture or graziery. But whatever were their occupations, nothing was allowed to prevent them from fulfilling the regulations of the setscha. These Cossacks were all of the Greek church; and the first fruits of their robbery were generally given to the church and its ministers. With the rest they bought handsome arms and clothes, or spent it in drinking, and in treating their comrades; and though they were active and temperate on their expeditions, they were lazy and gluttonous when at home. The Zaporogztsi could at times muster about 40,000 effective men. They were nominally under the sovereignty of Russia, and their bravery was often most successfully displayed in the campaigns of that power with the Tartars and Turks. Their services, however, were not always to be depended upon, as they sometimes changed sides when it suited their own interests or inclinations. One while they were with Poland, at another time with Russia, and even at times sided with the Tartars or the Porte. Peter the Great destroyed their setscha for joining in the rebellion of the Ukrainian Ataman Mazeppa; but they afterwards assembled under the protection of the Khan of the Crimea, and in 1737 were again admitted as Russian vassals. They still, however, lived in the same manner, and though formidable to their enemies, they were almost equally dreaded by their allies. They plundered the Russian merchants who passed through their territories, and interrupted, by continual piracies, the navigation of the Dnieper. These outrages, with their almost total neglect of agriculture in so fertile a country, and their constant resistance to every reformation in their government, determined the Empress Catherine II. to dissolve their confederacy; and in 1774 their setscha, which then stood at the junction of the Bouzoulook and the Dnieper, was surrounded, and destroyed by General Balmain, their arms were taken from them, and by an imperial manifesto they were allowed either to settle as

Cossacks of the Black Sea.

quiet and useful subjects, or to withdraw from the empire. Some of them took to agriculture and various trades, while others went over to the Tartars, or led a wandering life about the Russian frontiers. Many of them, however, afterwards returned and applied for military service; and as a reward for their zeal and bravery in the second Turkish war, the Empress, by an ukase of the 30th of June 1792, ceded to them their present residence, which was then newly conquered from the Kuban Tartars. They enjoy nearly the same privileges as the Don Cossacks. They have the full property of the soil, fisheries, and salt-marshes, and the right of distilling spirits. They also elect their own Atamans, but are immediately dependent on the governor of Taurida. They are, however, much poorer and more uncivilized than the Cossacks of the Don, and seldom quit their country, as they have sufficient employment at home in repressing the inroads of the Circassians. The Tchernomorski, according to Dr Clarke, bear no resemblance whatever to the Don Cossacks, either in habit, disposition, or in any other characteristic. "The Cossacks of the Don all wear the same uniform; those of the Black Sea any habit suiting their caprice. The Don Cossack is mild, affable, and polite; the Black Sea Cossack is blunt and even rude, from the boldness and martial hardihood of his manner. If poor, he appears clad like a primeval shepherd, or the wildest mountaineer; at the same time having his head bald, except one long braided lock from the crown, which is tucked behind the right ear. If rich, he is very lavish in costliness of dress, being covered with gold, silver, velvet, and the richest silks and cloths of every variety of colour; wearing at the same time short cropped hair, giving to his head the appearance of the finest busts of the ancient Romans."—"They are more cheerful and noisy than the Don Cossacks; turbulent in their mirth; vehement in conversation; somewhat querulous; and if not engaged in dispute, are generally laughing or singing." The braided lock on the crown of the head is the characteristic mark of the Tchernomorski, and distinguishes them from every other tribe of Cossacks in the Russian empire. It is preserved with religious veneration, and they would lose their life rather than part with it. This people are most dextrous horsemen, and when mounted have a noble and martial appearance. Their officers in general wear red boots, which is their principal distinction, and are otherwise very gaudily dressed; and still retain their ancient valour and love of war. They are held in little estimation by their neighbours on the Don, and are considered rather as an inferior band of plunderers, but without any sufficient reason. They are hospitable to the best of their means; and the following fact bears remarkable testimony to their honesty. When Mr Heber was travelling in this country, his companion Mr Thornton lost his gun, and supposing it to have been stolen, they left Ekaterinedara without the least hope of ever seeing it again. To their great surprise, however, when they arrived at Taman, the gun was brought to them, and notwithstanding the length of the journey, being above 200 English miles, the person who was employed to restore it to its owner refused to accept any reward for his labour.

The soil throughout the territory of the Tchernomorski is, in general, rich, but very little of it is in cultivation. They rear some cattle, and also most kinds of grain, as wheat, barley, oats, millet, rye, and maize. The climate, however, is in many places very unhealthy, and a great number of the inhabitants are annually swept away by malignant fevers. The commerce which they carry on with the Circassians consists chiefly in salt, for which they receive in exchange wood, honey, corn, mats, and arms. Their principal settlements are Taman, Temrook, Atshuef, and Ekaterinedara, or Catherine's Gift. This last is their capital, and the residence of their Ataman, and council of war. It has a very extraordinary appearance, consisting merely of a number of straggling cottages situated in the midst of a forest of oaks. The cottages, however, are remarkably neat, with a large area before the door, and an avenue of stately oaks; and their gardens are well stocked with vines, cucumbers, wall-melons, &c. The number of the Tchernomorski, including both sexes, amounts to about 20,000, among whom are 15,000 troops well disciplined and equipped. Of these a thousand are stationed along the lines to watch the motions of the restless Circassians; as many are kept as a body of reserve in and near the capital; and about a thousand are employed in the flotilla which lies in the Bugas. They have above a hundred pieces of cannon of different calibres, some of which are on board the flotilla; and the rest at various posts.

Cossacks of the Volga.

The Cossacks of the Volga, as well as all the other tribes of Cossacks towards the east, are a branch of the Don Cossacks. They at first only passed their summers on the Volga, and returned in winter to their stanitzas on the Don; but at last becoming stationary on the former river, they were declared independent of the parent stock in 1734. A few of them, however, only retain their Cossack constitution; the rest being placed under the usual municipal magistracy, as merchants, burghers, or boors, and consist of two regiments, the *Dubofskoy* and *Astrachanskoy*, which are kept in constant pay. The Dubofskoy are registered at about 1000 men fit for service, though they could easily triple that number. The Astrachanskoy are equally numerous, and are almost all in arms.

Grebenskoy Cossacks.

The Grebenskoy Cossacks, consisting of 1200 effective men in constant pay, are stationed in five fortified stanitzas along the Zerek, as a defence against the highland Tartars of Caucasus.

Orenbourg Cossacks.

The Orenbourg Cossacks inhabit the stanitzas along the Samara, and the upper parts of the Ural from the Ilek; and are employed in repelling the attacks, or in punishing the depredations of the Kirghises and Bashkirs. They could easily bring 20,000 men into the field, but only from 8000 to 10,000 are enrolled for military service.

Cossacks of the Ural.

The Cossacks of the Ural,* according to their tradition, first separated from the parent stock about the beginning of the fifteenth century, and established themselves at the mouth of the river Ural. They afterwards obtained a regular constitution from the Russian government, with the same privileges as the Cossacks of the Don. They now extend along the Ural from the Ilek to the Caspian, and perform service against the Kirghises. They live chiefly by fishing, and the breeding of cattle; and their number is computed at 30,000 men fit to bear arms, of whom a corps of 12,000 are always kept properly equipped.

Siberian Cossacks.

The Siberian Cossacks had their origin in a predatory expedition of a horde of Don Cossacks, who pro-

* They were formerly called the Cossacks of the Yaik, but having joined in the rebellion of Pugatchef in 1773, the Russian government, in order to efface the remembrance of it, changed their name, with that of the rivers and their capital, to those which they now bear.

ceeding eastward plundered and laid waste the Russian territories on the Volga; and embarking on the Caspian, made themselves formidable by their piracies to all the surrounding nations. The Tzar Ivan II. enraged at their depredations, assembled a considerable army to punish their audacity, which so terrified the robbers that they soon dispersed and fled into the neighbouring regions. A body of about 7000, however, still kept together under their Ataman Yermak, and advancing along the river Kama towards Permia ascended the Ural mountains. Immense wildernesses, and ferocious tribes before unknown to Europeans, now presented themselves, and would have stopt the progress of a less adventurous spirit than that of Yermak. But animated with the idea of founding a new and extensive empire, he descended eastward with his resolute companions, defeated the Tartar Khan, and passed the Tobol, the Irtish, and the Oby, subjugating in his victorious career the Tartars, Vogules, and Ostiaks. His little army, however, was soon diminished by battles and fatigue; and unable, with such scanty means, to accomplish his object by the establishment of a new kingdom, or to keep in obedience so many conquered nations, made over his conquests in 1581, to the Tzar Ivan, who nobly rewarded him for his magnanimity. But Yermak did not long enjoy his good fortune. He died about four years after. The discoveries and conquests, however, which he had so successfully begun were vigorously prosecuted by the Emperor, who sent thither reinforcements of Don Cossacks for that purpose, and who soon saw his dominions extend to the eastern ocean and the mountains of China. The Cossacks remained in the country as a militia, and many of them married with the natives. Their present number is said to exceed 100,000, but of those only 14,000 do military duty, the rest are engaged in various trades. See SIBERIA.

The whole number of the Cossack male population in the Russian dominions is reckoned at half a million; and of these about 200,000 are liable to be called on for government service of one description or other. See Clarke's *Travels,* vol. i. p. 227, &c.; Pallas' *Travels in Russia,* vol. i. p. 468, and vol. ii. p. 330; Tooke's *View of the Russian Empire,* vol. i. p. 390; Coxe's *Travels,* vol. ii. p. 275; Plescheef's *Survey of the Russian Empire,* p. 318; Chantreaux's *Travels,* vol. ii.; Hanway's *Travels,* vol. i. p. 97; Storch *Tableau de l'Empire de Russie,* vol. i. p. 25; and Campenhausen's *Travels,* p. 34, in Philips's Collection, vol. viii. (*p*)

COSSAE is a term applied to a species of cotton cloth, like most others originally imported from India, and differs so very little from calico in almost any particular, as to require very little description to those who have read that article. The cossae is generally finer than the calico, and like it, is chiefly used for the purpose of printing. It is rather lighter in the fabric, forming a kind of intermediate texture between that and the jacconott. They are most commonly woven in 1000, 1100, or 1200 reeds of the Scottish measure, or from 32 to 40 of the Lancashire measure. The breadth is generally given out by those who expose them to sale, as $\frac{7}{8}$ths of a yard, which is equivalent to $33\frac{1}{2}$ inches; but from the prevalent practice of rendering goods *apparently* cheap by deterioration of quality in almost every particular, they very frequently do not exceed 28 or 29 inches of actual measure. About No. 44 or 46 may be considered as nearly the average number of warp allotted to an 1100 reed. When it is found difficult to procure weavers to undertake these narrow goods, which is always the case when work is plentiful, the manufacturers are obliged to have them woven double the breadth, and to leave two intervals of the reed vacant in the middle to mark the division. These are afterwards cut asunder into two separate webs; and as one side of each piece will be deficient in what is termed the selvage, this deficiency is afterwards supplied by a slight sewing with the common needle. Although these goods are in general rather superior in point of quality to the narrow ones, from being generally better woven than the others, which must often be entrusted to unexperienced boys, a very general prejudice prevails against them; and the merchant always complains, that while a piece of the narrow goods with the double selvage remains on hand, he cannot dispose of them. Whether this arises from a jealousy, that the one side has been damaged and cut off, it is impossible to say, but the fact is certain. When cossae muslins are well fabricated and printed, they form an elegant and showy part of female attire, at a very cheap price, that of the cloth before printing seldom exceeding in wholesale quantities one shilling per yard. From this circumstance they are very saleable; and when the general muslin trade is even tolerably good, it is hardly possible to procure a sufficient number of weavers to supply nearly the demand. Capitalists, therefore, frequently take the advantage of occasional stagnations of the other branches to stock themselves largely at cheap rates. (J. D.)

COSSIGNEA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 183.

COSTUS, a genus of plants of the class Monandria, and order Monogynia. See BOTANY, p. 82.

COTE-D'OR, the name of one of the departments of France, formed out of part of Burgundy. It is bounded on the north by the department of the Aube, on the north-east by that of the Upper Maine, on the south-east by those of the Upper Saone and the Jura, on the south by that of the Saone and Loire, and on the west by those of the Nievre and the Yonne.

The soil of this department is in general bad, and is impoverished with weeds; but the rich plains in the district of Dijon produce plentiful crops of corn and hay. The principal products of the department are wine and iron. The famous Burgundy wine is produced from the chain of hills called the *Golden Coast,* on account of the profit which is drawn from this source. In the year 1806, no fewer than 322,842 pipes were made in the department.

The extent of the Cote-d'Or is 876,956 hectares, of which 207,600 are covered with forests. The annual contribution in taxes is 3,905,657 livres, and the population is 347,842 souls. The principal rivers are the Seine, the Saone, the Ouche, the Tille, &c. and the chief towns are Dijon, Chatillon, Semur, Beaune, Auxonne, and Nuits. (*w*)

COTES, ROGER, a celebrated mathematician, was born at Burbage in Leicestershire, on the 10th of July 1682, and was the son of the Rev. Robert Cotes, who was rector of that place. At the early age of eleven years, when he was receiving his education at the school of Leicester, he exhibited an ardent passion for geometry, which was fostered by his uncle Dr John Smith, who took young Cotes under his own roof, and anxiously superintended his mathematical studies. After having acquired at Leicester the elements both of classical and mathematical learning, he was sent to St Paul's school in London, where he made rapid progress in classical at-

Fig. 1. No. 1.

Plan

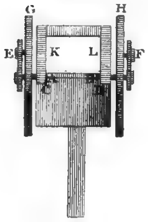


Fig. 1. No. 2.

Profile Section.

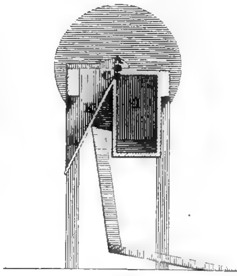


Fig. 1. No. 3.

Front Section

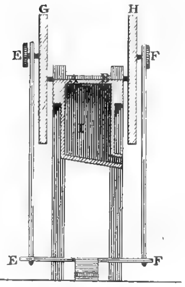


Fig. 2. No. 1.

Profile Section.

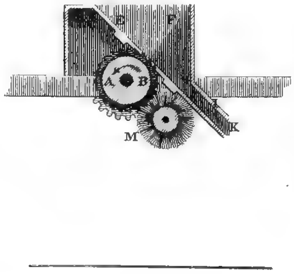


Fig. 2. No. 2.

Plan.

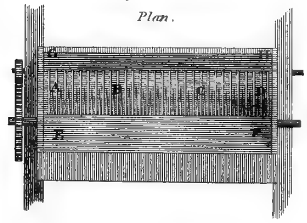


Fig. 3. No. 1.

End View Supposing the grating torn off as likewise the end Boarding.

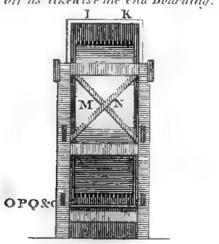


Fig. 3. No. 2.

Side View

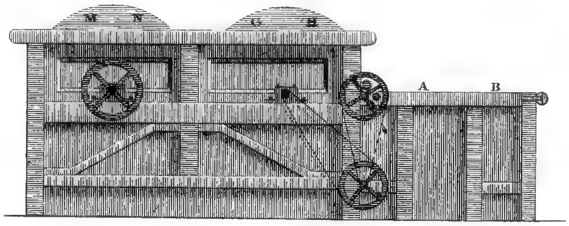


Fig. 2. No. 3.

Elevation

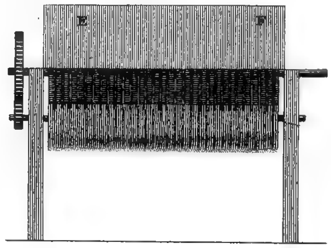


Fig. 4.

Improved Batting Machine

Vertical Section.

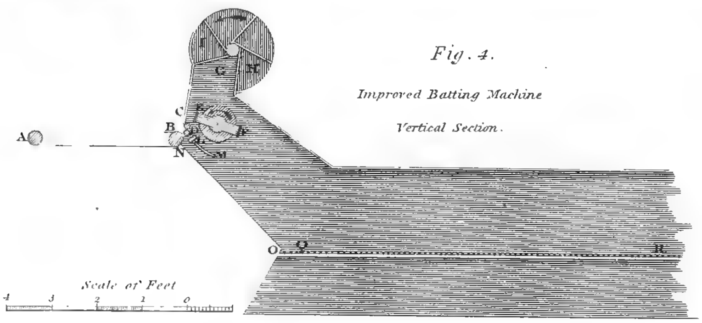
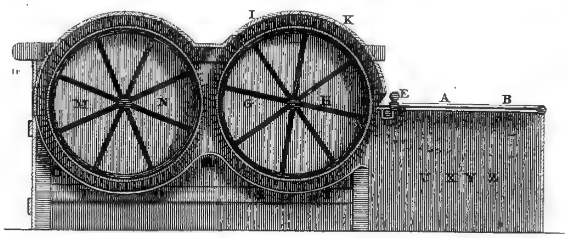


Fig. 3. No. 3.

Elevated Section



NEW DIAGONAL MULE.

Fig. 5.

Horizontal Plan.

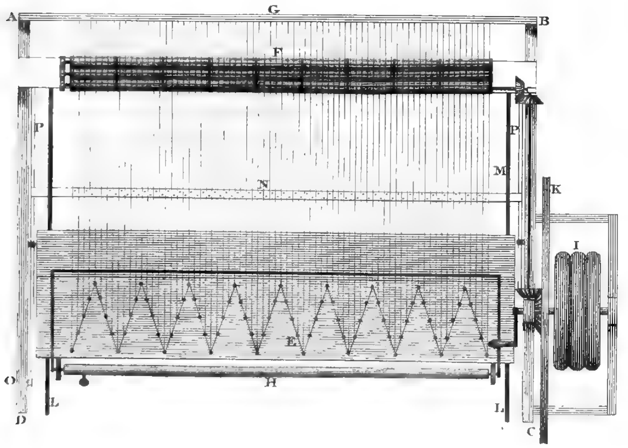
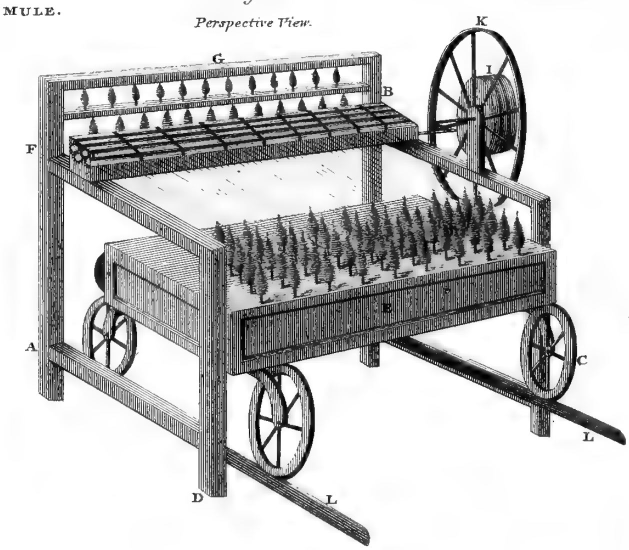


Fig. 6.

Perspective View.



Cotes.

tainments, without neglecting his favourite pursuits. In the month of April 1699, before he had completed his 17th year, he was admitted pensioner of Trinity College, Cambridge, and after having been appointed private tutor to the Earl of Harold, he was elected fellow of Trinity College in 1705. In January 1706, in the 24th year of his age, Cotes was unanimously appointed Plumian professor of astronomy and experimental philosophy, an office which he discharged with peculiar credit. In the same year, he took his degree of Master of Arts; and, in 1713, he entered into holy orders. The fame which Cotes had now obtained, was greatly increased by a new edition of Sir Isaac Newton's *Principia*, which he published at the desire of Dr Bentley, and which he enriched with an admirable preface; but he did not live long enough to extend his reputation, or to enjoy that portion of celebrity which he had already acquired. He was cut off in the prime of life, and in the vigour of his mind, on the 5th of June 1716, in the 33d year of his age. His remains were deposited in the chapel of Trinity College, and his friend Dr Bentley wrote a Latin inscription to his memory.

The only works which Mr Cotes published during his life, were his edition of the *Principia*, and a description of the Meteor of the 6th March 1715-16, which was printed in the Philosophical Transactions. The works which he left behind him, were, 1. the *Harmonia Mensurarum, sive Analysis et Synthesis per rationum angulorum mensuras promotæ*, which was edited and enlarged by his relation Dr Robert Smith. 2. *Hydrostatical and Pneumatical Lectures*, a work which he refused to publish during his life.

The reputation of Mr Cotes is founded chiefly upon the elegant geometrical theorem, now universally known by the name of the *Cotesian theorem*, which was found among his papers without any demonstration, and of which we have given a full account in our article on the ARITHMETIC *of Sines*, (Vol. II. p. 438, 439). He had the high satisfaction of enjoying the esteem of Sir Isaac Newton, who particularly lamented his premature death, and remarked, that had "Cotes lived, he would have done something for science." See Dr Pemberton's *Epist. de Cotesii inventis*, and De Moivre's *Miscellanea Analytica*. (*w*)

COTES DU NORD, the name of one of the departments of France, formed out of Upper Brittany. It is bounded by the British Channel on the north, from which circumstance it derives its name; by the department of Ille and Villaine on the east; by that of Morbihan on the south; and on the west by that of Finisterre.

This department contains extensive tracts of heath; but the arable land is very fertile, and produces corn, hemp, and flax. The pastures are extremely good, and the orchards, which are numerous, abound in apples, of which considerable quantities of cyder are made. Iron and lead likewise occur.

The extent of this department is 736,720 hectares, of which 23,876 are covered with forests. The annual contribution in taxes was 2,549,791 livres, and the population is 499,927 souls. The principal rivers are the Guet, the Treguier, the Argueron, the Ranxe, the Lie, the Oust, and the Blavet. The chief towns are St Brieuc, Loudeac, Dinan, Guingamp, Lanion, and Plestin. (*w*)

COTTON.

Cotton.

COTTON is a name, which, in common language, is very loosely given to any vegetable filamentous substance; but it is correctly appropriated to that peculiar vegetable matter, consisting of innumerable fine filaments, arranged together within an external coat, and enveloping the seeds of the genus Gossypium. This genus is found in both the Indies, in Africa, and in the warmer parts of Europe; but its cultivation to any extent is, in a great measure, confined to the East and West Indies. This genus belongs to the class Monadelphia, order Polyandria, (see BOTANY,) and possesses the following characters: Calyx double; exteriorly 3 cleft. Capsule quadrilocular. Seeds involved in cotton. Botanists enumerate ten species of Gossypium, the characteristic distinctions of which are to be found in the form of the leaf, and in the size of the tree. Willdenow has given the following species:

1. Gossypium Herbaceum.
2. . . . . Indicum.
3. . . . . Micranthum.
4. . . . . Arboreum.
5. . . . . Vitifolium.
6. . . . . Hirsutum.
7. . . . . Religiosum.
8. . . . . Latifolium.
9. . . . . Barbadense.
10. . . . . Peruvianum.

If, however, the observations of M. Lasteyrie be correct, the number of species should be considerably augmented; but that writer has betrayed such gross ignorance, and so strong a disposition to mis-statement with regard to facts, of which we have means of judging, that we should not adopt any opinion advanced by him without the sanction of some respectable authority. Only a few of the species are cultivated by Europeans. The mode of cultivation differs but in the general detail. We shall point out as accurately as we can, the prevailing modes, as well as any remarkable differences, so as to convey pretty accurate general ideas of the subject. The mode of cultivation depends on the plant being annual or perennial. The general preparation of the soil must be influenced by the climate, and other incidental circumstances that cannot be properly detailed in this place. In general, the annual cotton tree thrives best in a dry gravelly soil. It is also said to answer better in old than in newly cultivated land. An exposure to the east, where the country is hilly, is considered by some to be of importance. The culture begins in March and April during the rainy weather. Holes are then made in rows at the distance of from seven to eight feet; into each of these an indefinite quantity of cotton seed is put: in a short time they germinate; and as soon as the young plants rise to a height of six or seven inches, all, excepting two or three of the most vigorous, are pulled up by the roots. The surviving plants are pruned twice before the month of August, so as to keep them down to the height of about four feet. This is absolutely necessary, as when there is a great abundance, the difficulty of gathering the cotton is increased without any addition to the quantity. Great care is required to free the plantations from weeds. Light showery weather is the most favourable to the plentifulness of the crop.

Mode of cultivation.

In some parts, particularly on the coasts of Guiana and the Brazils, the perennial cotton tree is almost exclusively cultivated. Of this we are enabled to give a very accurate account, which we have derived from an acute and intelligent planter in the colony of Demerary, where the cultivation of cotton has been carried to a high pitch of perfection. On the coast of Guiana the land is all alluvial mud, thrown out of the great rivers that empty themselves into the ocean in its immediate neighbourhood. Land is daily formed by the same causes. The elevation above the level of the sea is so inconsiderable as to render inundations not uncommon, and the whole country is intersected by ditches, without which no cultivation could be carried on. This peculiarity of the country is to be considered, whatever is the object of cultivation; but there are some particulars that are to be exclusively attended to by the cotton planter. The land in which cotton is to be planted must be formed into beds of about 36 feet wide, which are to be surrounded by drains that run across the estate, and empty themselves into the trenches that run parallel with the length of the estate. These beds should be slightly elevated towards the middle by means of the soil dug out of the drains, so as to throw off the superabundant water more readily than if they were perfectly horizontal. This is peculiarly necessary, as any stagnation of the water around the root of the tree is very injurious to it in every stage of its growth. When the land has been thus prepared, it is divided into squares of from three to six feet, according to its nature, but the average is about five feet. Some indeed do not divide the surface into squares, but into parallelograms of five feet by four. The squares are marked out by a line prepared for that purpose, or by pickets stuck into the ground, in which small holes, four or five inches deep, and six or eight wide, are dug with a hoe, a little light earth is then scraped into the hole, and a small handful of seed laid upon it; the whole is then lightly covered with earth. If the weather be showery, (which it ought to be when cotton is planted,) the seed will spring up in three or four days. When the plants are three or four inches high, they ought to be pulled by the hand, leaving three or four in each hole. This is generally done within a month after the first planting. About the same time the ground generally requires a first weeding, which must be repeated every month, until the trees are fully grown. At the second or third weeding, one tree only is left in each hole, and then if it be eighteen inches, or two feet high, the tops are nipped off to make the tree throw out a sufficient number of lateral shoots. The usual period of planting cotton in Dutch Guiana is during the months of December, January, April and May. If in the two first months, which are preferable, the tree will require to be pruned in June, to prevent its becoming too high. This is done about three feet above the ground, at the same time all the shoots from the stem above one foot from the ground are pulled off. But if the cotton be planted in April and May, the branches will only require to be nipped about twice with the finger, and the plant will generally yield some cotton before Christmas, indeed from the month of October if the weather be dry. In general, however, the cotton tree rarely produces a full crop before it has attained its second year, and its duration is generally estimated at four or five years. The replanting is not done in any regular way, but whenever a tree fails another is planted in its place, which is called supplying a field of cotton. This is particularly attended to at the period of weeding. The cotton trees that are a year old are regularly pruned once a year, between the months of April and July. The time of beginning depends in a great measure on the weather, and the prospect of the trees yielding any more.

In regular seasons, the crop in Guiana is generally finished in April, and if the season be mild, May is the fittest month for pruning, which generally employs the gang for about a month. The fields must be previously weeded, care being taken to cut out all the old or rotten branches, to regulate the distance of these branches, as well as the height of the tree, which should be about four feet. This last circumstance must depend in a considerable degree on the nature of the soil. After the pruning, the utmost attention should be paid to keeping the ground free from grass and weeds, which grow very rapidly at that season. To produce the desired effect, the fields should be weeded thrice between the pruning and the gathering in of the crop. This must be regulated by the number of people on the estate. The cotton, if the season be favourable, begins to throw out abundance of blossom by the end of July, or the beginning of August; the pods form in succession, and generally begin to open in about six weeks: it rarely happens that there is any general picking before the end of October, and it continues till about the end of December, making what is called the first crop. The short rainy season then begins, and during its continuance the trees vegetate with uncommon vigour, and blossom. The second crop, when the weather is mild, should commence by the end of February, and continue to the middle of April. To ensure the vigour of the trees, the fields should be weeded between the first and the second crop; if possible, immediately on the close of the first. Little confidence can, however, be placed in the expectation of a second crop, from the prevalence in Guiana of cold northerly winds, accompanied with much rain from December to April. These always injure, and generally destroy, the crop, either by making the blossoms and young pods drop from the trees, or if the latter arrive at maturity, by making the seed and cotton stick to each other instead of bursting freely. The disease thus induced is called the blast; and we shall give a more particular account of it hereafter.

In the West India islands, and in Georgia, the same mode of cultivation is pursued. The cotton trees, however, must be annually planted, owing to some local peculiarities.

In Guiana the pure blue clay is considered the best for this species of growth, particularly that which is daily forming along the shores of that part of South America. From this fact, it has been inferred, that salt promotes the growth of the cotton tree; and, in conformity with that opinion, the old lands are frequently inundated with salt water, and we believe with very considerable benefit. Other soils, such, for instance, as are sandy and gravelly, are equally productive with the clay, provided they be situated near the sea. This is particularly the case in the West India islands. There is an exception to this observation in the interior of Georgia, where cotton grows very abundantly. Possibly the cotton of Georgia may be a particular species, and this idea is borne out by the fact of the Georgia cotton being much inferior to that of the sea islands.

Several species of cotton have been tried in Guiana, but none succeed so well as the loose and close seeded cotton. The last of these is preferred.

After the cotton has been gathered, it is dried in the sun until the seed becomes quite hard, otherwise it would heat and spoil. It in general requires to be laid out three days on a tile, or wooden platform, exposed to hot sun. The seed is then separated by passing the cotton between two slightly grooved wooden rollers, of a diameter of a quarter of an inch. These rollers are driven by treddles, put into motion by a negro's foot, whilst he presses the cotton between them with his hands. This machine is called a gin. A good workman can gin from 50 to 60 lbs. per day; but the labour is so great, that the same people ought not to be kept at work for more than a fortnight together. After the cotton has been ginned, it is carefully picked by women, who free it from broken seeds, dried leafs, or yellow locks of cotton. An expert woman will prepare from 25 to 30 lbs. per day. Some people switch it, and the cleaning is undoubtedly much facilitated by it, but as it has been disapproved of by the manufacturers, it has been very generally discontinued.

After the cotton has been thus cleaned, it is packed in bales, into which it is compressed by means of a screw. In this state it is sent to Europe, and employed for the various beautiful fabrics that do such infinite credit to British exertion and ingenuity. See Cotton Machinery.

It would be foreign to the object of the present article to enter into any details respecting the wonderful and beautiful degree of perfection at which our manufacturers have at length arrived. It may be sufficient to observe, that they far surpass those of any other nation, and that there is not the most remote chance of their being exceeded, until some country should unexpectedly call forth resources and treasures of which we cannot at present form even an imperfect conception.

Diseases of the cotton plant.

From the consideration of the plant in its perfect state, we naturally turn to the diseases to which it is obnoxious; and we have much pleasure in laying before our readers the observations which follow, as we have derived them from a gentleman whose high character and liberal attainment have long rendered him conspicuous among the few men of observation and talent that resort to the western hemisphere. To Dr Chisholm of Clifton we owe the whole of that valuable information which we are about to detail, and which he has afforded in the most liberal and generous manner.

The cotton plant is particularly attacked by an insect that receives the general name of chenille, or cotton caterpillar, and by a particular blight called the blast. Of the caterpillar we shall give the account in Dr Chisholm's own words: "The chenille, or cotton caterpillar, is generally about an inch, or an inch and a half in length. Its general appearance is beautiful. A single line of white runs down the whole length of the back, and a double line of the same colour parallel to this runs down each side; the intermediate spaces of the back and sides are of a fine glossy black, covered with soft down, intermixed with short black bristles; the belly is yellow, inclining to white; and the respiratory organs are in number double that of the rings composing the body, viz. twenty. The head is rounded, black and corneous, and armed with two lateral corneous jaws, constituting a cutting forceps, of most rapacious and destructive power. I have reason to believe, that this species of the phalæna has not been hitherto described by entomologists; at least I do not find in Linnæus, and the other writers on the subject I have consulted, any thing. Until, therefore, a better is given, I offer the following character:

Phalæna geometra seticornis alis omnibus subgriseis subangulatis deflexis.

Larva subpilosa, setulis nigris interpositis; 12-poda, 20-annulata, dorso nigro nitido, linea dorsali, lineolis geminis lateralibus flavescentibus albis—abdomine albo flavescente. Pupa obtecta, subovalis, fusca-nigrescens, coriacea.

Habitat in Guiana, Gossypii variis, forsan omnibus, speciebus, quarum folia petiolos fructusque etiam immaturos mira diraque voracitate, devorat.

One of the most singular circumstances respecting this species of the phalæna, is the uncommonly fragrant smell which issues from the plant on which it feeds, although neither the animal itself nor the plant is possessed of any fragrance separately. I have often endeavoured to ascertain the cause of this singularity, by bruising the insect, and the leaves of the cotton tree, but without being able to perceive any remarkable peculiarity of odour. So powerful, however, is the odour produced by the ravages of this caterpillar, that it may be perceived more than a hundred yards from the plant. Another equally singular circumstance is the manner in which the ova of this insect are preserved—a circumstance, until of late, extremely puzzling to the entomologist. A whole year may occur sometimes without any appearance of the chenille; and notwithstanding this, the year immediately following may be marked by the most extensive proofs of its voracity. Where, in the mean time, are the ova preserved? Some curious planters, with a view to ascertain this point, and to destroy the brood of so pernicious an insect, have cut down and burnt the cotton trees, on which we must suppose it deposits its eggs, and have also burnt the grass, and every other vegetable production of the land which it has infested; but without being successful in preventing a renewal of the ravages of the insect on the new plant on the following year. Infusing the seeds in the strongest brine and decoction of tobacco has been resorted to with a similar result. The ova of this species of phalæna seem, therefore, to be of the nature of those which may remain long unchanged; whose fecundation may require the agency of a very considerable degree of heat; and whose vitality may resist the power of chemical agents, and the fervour of ignition itself. Until this ideosyncracy, if I may so apply the word, of the ova of certain tribes of insects was discovered, the permanency of the brood of the cotton moth, notwithstanding the application of fire to the plants on which they have been deposited, was considered as altogether inexplicable. The discovery of Spallanzani, more especially, has thrown light on this singular quality, which completely divests it of mystery, whilst it raises our astonishment to a tenfold degree. The observations of M. M. Humboldt and Bonpland have confirmed the fact; and the ingenious and learned Mr Good, were more wanting, has, by some very curious additional facts, established the knowledge of this most wonderful economy of nature. See Mr Good's *Anniversary Oration before the Medical Society of London*, March 1808, p. 30—34.

A third curious observation relative to the history of the cotton moth and caterpillar, is the rapidity with which it carries its ravages to distinct and even distant fields of the plantation. We should indeed be inclined to imagine, that the wind has much agency in spreading its destructive progeny; for, in the course of a single night, whole fields, consisting of from four to ten acres, hitherto unmolested, have been devoured by them. Or does this proceed from the flight of myriads of the insect in its perfect state to distant fields, and then depositing their eggs, whose fecundation is quickened by the fostering heat of a favourable season, and thus giving rise to these sudden and astonishing colonizations. That the leaves of the cotton tree are the nidi as well as the food of the chenille is evident, from operations of the caterpillar when preparing for its change into the pupa state. By means of a thready substance resembling a spider's web, of a white colour, the leaf which the larva intends for the scene of its transformation is drawn together, so as to form a funnel-shaped fold, close at the edges, and shut up at the broadest part or base. The pupa is inclosed in a covering of the thready substance, and acquires its perfect form, or image, at the expiration of nine days. The moth is small, never exceeding an inch from the head to the extremity of the wings, of a gray, inclining to black colour. Immediately after dusk, in those seasons which are unfavourable to their propagation, myriads approach the candles, and are very troublesome, but soon terminate their existence in its flame. The period of their existence, when not destroyed by such causes, is about nine days; and the whole life of the insect, including all its transformations from the ovum to the death of the moth, is about twenty-seven days. In the pupa state, the insect is subjected to the rapacity of several other insects. Those I have more particularly observed, are a small species of apterous bug, I believe the *cimex grylloides*, and the common red ant. These are often found in the hollow folded leaf, having the means of disengaging themselves from it by a cylindrical passage penetrating to the helpless pupa, of which, when these insects infest it, nothing remains but the shell, or coriaceous coat.

The evolution of the larvæ, and the transformations and death of the insect, or the appearance and disappearance of the chenille, are certainly regulated or influenced by particular states of the atmosphere, and by the phases or changes of the moon. The chenille, or larva of the cotton moth, generally appears, in years favouring the fecundation of its ova, in July or August, a few days before the new moon, increases during the increase of the moon, and nearly about the full moon begins to disappear, and soon after ceases altogether. Happily for the planter, however, this happens only every second or third year. But in years uncommonly favourable, the chenille thus appears and disappears every month from July to October, and afterwards from the middle of January to the beginning of March. How are these changes effected? How should the action of the moon's greater or less pressure influence the propagation and destruction of this insect? Is it because there may be a natural provision for the insect, by the flux of vegetable juices, during the increase of the moon? Or finally, is it because there may be then a peculiar temperature of the air more favourable to the fecundation of the ova of the insect? These propositions involve disquisitions of infinite latitude and obscurity; therefore, instead of attempting to institute a theory capable of explaining these phenomena, it will be more useful to state the circumstances which have occurred during my residence in Demerary, at the periods of their appearance and disappearance, and leave to the judicious reader their application.

During the month of January 1801, the weather was clear, dry, and pleasant, till the 23d, with a temperature marked by 84° of the thermometer. The 23d and 24th were cloudy and rainy, with westerly and southerly winds, and the thermometer sunk to 82°. The remainder of the month was pleasant, with strong breezes at north-east and east, and thermometer 84°. The changes of the moon were as follows: New moon 14th, 1st quarter 21st; full moon 29th; rain 15.23. On the 28th, the chenille was perceived on several parts of the coast.

February began with rain and a low temperature; thermometer 80°. From 3d to 21st pleasant; wind rather boisterous, at north and north-east, and thermometer generally 83°. The remainder of the month chilly and extremely rainy, with variable winds, and thermometer sometimes as low as 76°. New moon 12th, first quarter 20th, full moon 28th. The chenille appeared on Success plantation on the 19th, and towards the end of the month was most destructive.

March was showery during nearly one half, the other half dry. Thermometer from 80° to 86°. No chenille appeared.

In these months the appearance of the chenille seems to have been regulated by the weather and the state of vegetation consequent thereupon, as well as the changes of the moon; for it came on when rains had rendered the cotton trees succulent, and when the moon was in the increase. There seems to be something at the period of spring when the chenille entirely disappeared; the month of March particularly inimical to the insect; for I have never seen it later than February.

The month of July, until the 9th, was pleasant, with occasional showers. Wind north-east, and thermometer 86° to 87°. The remainder was constantly rainy; it was also distinguished by a very extraordinary quantity of lightning in the south-west, from which the wind also blew. On the 15th thunder; thermometer from 80° to 87°. New moon 10th, first quarter 18th, full 25th. The chenille first perceived on the 15th, and increased till the 24th, and entirely disappeared about the 29th.

No rain in August till the 18th, but a good deal of thunder and lightning in the west on the 11th and 17th, wind north-east, and thermometer 86° to 88°. The remainder of the month generally showery, and once heavy rain on the 18th, but much thunder and lightning, and thermometer varied from 78° to 88°. The whole month was remarkable for coruscant lightning in the evenings, land winds and heavy dew at night. New moon 9th, 1st quarter 17th; full moon 23d, last quarter 30th. Chenille appeared on the 9th, and increased much towards 16th, and on 23d disappeared altogether.

September was generally pleasant and dry, although much thunder and lightning. Thermometer from 86° to 88°, wind north-east. New moon 8th, 1st quarter 15th; full moon 22d, last quarter 29th. On the 3d, the chenille began to appear, and by the 10th universal on the whole coast, from Demerary to Bubiu rivers, and so destructive, that the cotton trees were bared entirely of their leaves. On 15th chenille gone, and on 20th trees beginning to recover.

On the 7th October, an eclipse, with a strong gale west and south-west, some rain, and general haze. Almost all the rest of the month dry, and thermometer from 86° to 88°. But the whole of the month remarkable for thick fog all night and morning, more especially from the 8th, the smell of which was particularly offensive. The atmosphere charged with hydrogenous gas and very oppressive. New moon 7th, first quarter

14th, full moon 21st, last quarter 29th. The chenille on the 4th perceived partial on several spots of Success. Towards the 10th, instead of suddenly disappearing, and the pupæ being exhibited in the manner I have described, the larvæ were universally seen languid and motionless; and on the 15th they were every where dead and putrid on the leaves.

In the months of July, August, September, and October, we perceive the same causes giving life and activity to the chenille; and until the 10th October we also see that the ova were deposited and fecundated into a fresh brood of the insect at the same periods of each month. There are two circumstances particularly remarkable in this period, which do not seem to have existed in the preceding spring; the first is the astonishing quantity of thunder and lightning, and more especially of that kind of corruscation, which, from the time of the day in which it occurred, may be called crepuscular lightning. This was more especially observed on the 15th July, and on that day the chenille was first perceived; it is also singular that this did not seem to be regulated by any change of the moon. The same species of lightning also occurred in August, and was nearly concomitant with the reappearance of the chenille. The second circumstance is the extraordinary fog in October, attended with an offensive sulphureous or hepatised smell. This had not been observed by me before; but its effect on the chenille seems to have been wonderfully great. The impregnation of hydrogenous gas commenced on the 8th, and on that very day the chenille began to languish, and by the 10th scarcely an insect remained alive, nor were there the usual depositions of ova, nor apparently any provision made for a succession of the animal. This is certainly a phenomenon of uncommon importance, because it points out, with tolerable certainty, the best means of destroying the chenille; and gives stability to what has hitherto been little more than speculation, viz. that the vapour of burning sulphur is the appropriate remedy for the evil.

The consideration of the foregoing particulars seems to lead to the following inferences: 1st, That lightning and thunder dissipating obnoxious vapours, particularly those of a hepatised and hydrogenous nature, and thereby rendering the atmosphere more capable of aiding the process of vegetation, favours the fecundation of the ova, and the future progress of the insect to the perfect moth state, by providing a fostering heat, and a larger quantity of appropriate nourishment. 2d, That the accumulation of hepatised and hydrogenous gas in the atmosphere, by checking the process of vegetation, and by having a direct morbid action on the organs of the chenille, is inimical to their existence, and to their future generation. 3d, That it is probably for this reason that moderately dry weather, with north-east and easterly and south-easterly winds, when the vegetation of the cotton plant is most vigorous, favour the developement of the insect, and that southerly and westerly or land winds, tend towards their destruction; the former being pure and uncontaminated by any noxious impregnations, and seem rather, if different from pure atmospheric air, to be superoxygenated; the latter, on the contrary, always more or less loaded with hydrogenous or hydrocarbonic and hepatised gas, and being not only destructive to the chenille, but in the highest degree injurious to the human constitution.

Although the planters anathematise this destructive insect, with all the virulence of Ernulphus, it does not appear that any thing effectual has been attempted to prevent or destroy the evil. It is, however, of so serious and important a nature, that something should be done. Analogy points out the use of sulphureous vapours for this purpose, and the direct effect of similar vapours naturally applied to the chenille, confirms the propriety of the remedy. The only objection to it of any weight I have ever heard proposed, is founded on the supposed expence in purchasing the apparatus, and on the labour required for the effectual application of it to the trees individually; for in no other way can it be made effectual. But the judicious and truly economical planter finds that the calculation of these gives a result rendering them extremely trifling, when compared to the prodigious loss sustained by permitting the evil to exist. A small chaffing dish on which the sulphur is burnt, and a painted canvass cone to be placed over the tree for the purpose of concentrating the vapour, are all the apparatus required; one person to hold the chaffing dish under the tree, and another to place the cone over it, are sufficient for each tree; and ten minutes application of the vapour, is all the labour. Now, if a gang of 200 negroes, for all sexes and ages may be employed in this work, are put into a piece of chenilled cotton, with 100 sets of the apparatus, they will destroy the larvæ and pupæ spread over an acre in one hour, supposing the acre to have 600 trees growing on it, which is the usual calculation.—One acre of cotton trees in full vigour, and uninjured by the evils to which the plant is subject, will yield 400 lbs. of clean cotton, which at a medium price will sell for £40 sterling. The apparatus may be estimated at £60.—So that the expence bestowed on the destruction of the chenille of ten acres, the probable amount of a day's labour of a gang of 200 negroes, will not exceed, including the first cost of apparatus and the hire of the negroes, £80; while the produce of the land gained by this expence will be £400, leaving a balance of £320; and the second ten acres thus treated, as there will be no charge for apparatus, will consequently give a clear gain of £380. But if we consider that if the remedy is not applied there will be no produce, the magnitude of gain may be estimated at a much higher rate. The adoption of this remedy should therefore on no account be neglected.

A prudent economical planter will increase the brood of every species of domestic poultry, particularly turkies; for this has a tendency to diminish the brood of chenille in a very great degree, while profit arises from the augmentation of useful stock. Turkies are observed to have a remarkable appetite for the larvæ of the cotton moth, and devour prodigies quantities of them. But the most usual natural enemy of the chenille is the bird called in the colony Chenille bird, (the black and yellow Manakyn of Edwards, or the Pipea aureola of Linnæus,) and the Certhia familiaris or house wren, and the Parus Niger of Linnæus, mentioned by Dr Bancroft, (*N. Hist. of Guiana*, p. 182.) The former of these appears on the coast with the chenille, and quits it at the same time it does, and the flocks are numerous in proportion to the quantity of the insect.

A remedy has been proposed and tried in England for caterpillars, slugs, grubs, and other insects infesting fruit trees and vegetable esculents, with considerable success. I saw the experiment made by a gardener of the name of Macpherson at Bath, and I had much reason to approve of it. I therefore recommended it to my friends in Demerary, but I believe unavailingly, and for the reason which constitutes so frivolous an objection to the fumigation with sulphuric vapour. It possesses the merit of simplicity, being nothing more than the scattering of finely powdered quicklime over the leaves of the trees and plants on which the insects are, early in the morning when they are moist with dew. If any particles of the lime adhere to the insect, it inevitably perishes.

The blast or blight is another evil the cotton tree is subject to; and as its tendency is to check or destroy the vegetative powers of the plant, and consequently to deprive it of all its productive faculties for a season, it is perhaps an evil of greater magnitude than even the chenille. I shall therefore, as I have already attempted relative to the chenille, present such observations as have occurred to me, during my residence in Demerary, as a planter, on the nature, causes, and means of remedying it.

The magnitude of the evil, and the causes to which blast or blight was anciently assigned, Pliny thus expresses, (*Nat. Hist.* l. xviii. c. 17.) *Cœleste fragum vinearumque malum nullo minus noxium est rubigo. Frequentissima hæc in roscido tractu, convallibusque ac perflatum non habentibus. E diverso carent ea ventosa, et excelsa.* In another place he enumerates the names the blight was distinguished by, (c. 28.) *Aliis rubiginem, aliis uredinem, aliis carbunculum appellantibus, omnibus vero sterilitatem.* Of these appellations, *uredo* is perhaps the most applicable, and most expressive of the appearance of plants suffering under this disease. The cotton trees more especially look as if burnt, the leaves, stem, and pods exhibiting the marks of a scorching fire. Pliny seems to have possessed a perfect knowledge of the causes of blight, when he thus speaks of them; *Plerique dixere rorem inustum sole acri frugibus rubiginis causam esse, et carbunculi vitibus: quod ex parte falsum, arbitror, omnemque uredinem* frigore *tantum constare, sole innoxio. Id manifestum fiet attendentibus. Nam primum omnium non hoc evenire, nisi noctibus et ante solis ardorem, deprehenditur.* (*Ibid.* Ed. Harduin, folio). The very accurate observations of Ramazzini have given precisely the same result, and proved the efficiency of a cause exactly similar in effect to that which I shall describe in Demerary. In the year 1690, in Modena and the contiguous districts of Italy, prodigious rain and consequent inundation took place. *Perstitit deinde eadem pluviosa constitutio, non solum toto veris tempore, sed per totam fere æstatem ut nulla pene dies sine pluvia visa fuerit. Hinc factum, quod* una cum pluviis flante ut plurimum Borea, *nulla unquam æstas nostro in hoc climate exstiterit, in qua remissior fuerit caliditas, &c.—Sub initio Junii denuo, sicut anno anteacto, apparuere signa Rubiginis.* The whole vegetable kingdom suffered by this *pessimus omnium frugum morbus*, &c. (See Ramazz. *Constitutio Epidemica Ruralis*, 1690. *Oper.* Ed. 1718, p. 69, 70.) That this has been chiefly efficient in the production of this disheartening calamity in Demerary, will appear from the following detail of facts; and it is the more deserving our notice, as it goes far to prove the identity of disease produced in the temperate and tropic climates, in countries distant from each other more than thirty-eight degrees of latitude, by a cause of precisely the same nature, and which, in relation to each country, acts with precisely the same degree of power.

During the spring of 1801, an opportunity, fatal to the crop of cotton, afforded ample means of ascertaining the causes and nature of blast, and gave room to believe, that a remedy is not impracticable. Early in the month of November, the rainy season was anticipated considerably, and presented a prospect extremely discouraging to those planters who had been late in pruning their cotton trees, which, owing to that cause, had not as yet arrived at maturity. Success estate was precisely in this predicament. The consequence in general was, the trees in most instances became sickly, and the pods reluctantly opened to a solar heat seldom exceeding 80° and 82°. During December, more than two feet of water fell and inundated the fields; and scarcely had we emerged from this calamity, when in January another flood reduced us to the same situation. Distressing as these circumstances were, the immediate consequence would not have been fatal, had no other succeeded. The trees lost nothing of their verdure and towards the end of the month, a pleasing and universal display of blossoms raised apparently well-founded hopes of an ample second crop. About the 28th, however, the chenille began to appear, and towards the middle of February became very general on the estate, when a third prodigious fall of rain contributed to shake the hopes we had formed. Notwithstanding this succession of unfavourable events, the cotton trees being vigorous, and throwing out an immensity of blossoms, I still flattered myself, that the second crop would compensate the loss of the first. Towards the end of February the north wind set in, and frequently sunk the thermometer to the 70th degree. This was decisive; for, although the month of March was showery, yet it was very considerably warmer, and the trees exhibited a yellowness of leaf, a dried as if scorched stem, the blossoms and forms fell effæte, the pods approaching to maturity acquired a black hue, and their foot-stalks becoming shrivelled, sapless, and at last rotten, afforded no longer a support, and they also fell hardened, black, and useless. The preceding year having been marked by a series of circumstances, the very opposite to those I have described, was also marked by the wonderful fecundity of the cotton trees during the months of February, March, and April. The one year gave a crop of near a hundred thousand weight; the immediately following one, a crop of fourteen thousand, of bad, scarcely marketable, cotton.

In the consideration of these facts, we perhaps may perceive the causes, the nature, and in some measure the remedy of the blast. The late pruning had deprived the cotton trees of sufficient time to acquire that state of maturity, which enables them to yield their fruit abundantly, when heavy rains, and the accumulation of water round their roots, surcharged them with juices, and created a fresh and overpowering *spring*, retarding the opening of their pods. At length a plethora took place, and the fruit was destroyed, without materially injuring the trees. Whilst recovering from the effects of this, a new morbid cause interposed, and again reduced the trees to the necessity of casting off their immature fruit, and to a disease of a still more formidable nature invading their whole structure. The state of the atmosphere towards the end of February, had allowed the irritability of the trees to accumulate, (to use the language of the late Dr Garnet,) and the heat of March acting upon this morbidly accumulated irritability, overpowered it, bringing on a state of exhausted irritability and gangrene. Had the same temperature of atmosphere continued, no such fatal event could have taken place. Hence the causes of the blast of cotton trees appear two-fold,—an excess of vegetation, corresponding with plethora in animals, and exhaustion of vegetation, terminating in a state similar to gangrene: the first followed by the destruction of the fruit only; the second by the almost total destruction of the plant, which recovers its health and functions only by pruning and a favourable season. The reasoning of Dr Garnet, as it relates to the last of these diseases, is perfectly applicable to the blast of the cotton trees of Demerary. "I am pretty well convinced," says he, "not only from a number of facts which I have myself observed, and which I have stated fully in my Lectures, but also from the observations of Uslar, that blight *is almost always* a species of gangrene or mortification, brought on by the action of the rays of the sun in the spring on the morbidly accumulated irritability, which had been produced by a considerable subtraction of heat during the night. A frosty night succeeded by a cloudy or misty morning, is never attended with those effects which almost certainly follow, if, when the spring is considerably advanced, a frost should be succeeded by a fine warm morning." The difference of temperature in Demerary, between 88° and 70°, suddenly applied to the cotton trees, will produce the same effect, as a frosty night (36°) succeeded by a warm morning (54°) on the fruit trees of the north of England. In both countries, it is the *rapidi potentia solis acrior*, followed or preceded by the *boreæ penetrabile frigus* of Virgil, *adurans*, or burning, or blasting the trees. Thus heat and cold are relative terms; and, in the present instance, that degree of the latter which in Great Britain is called frosty within the tropics, is, to our senses, greater than the medium summer heat of the former country; and that which constitutes what is considered a fine morning heat in the one, would be altogether unsupportably cold in the other; nevertheless, the power of the corresponding temperatures in both countries is precisely the same, producing the same mischievous effect.

There is another cause of blast, which exists in countries circumstanced as Demerary is, and which arises from the structure of the plant itself. I mean the destruction of the root of the cotton tree, or the injury it receives when, from the circumstances of the situation in which the plant is placed, the root is continually, or for a considerable length of time, immersed in moisture. The cause of injury proceeding from moisture thus applied, is the structure of the root, which is somewhat fusiform or tap-rooted. This is proved by a simple experiment. Let several rows of cotton trees be planted on a gently sloping dam or mound of earth, at the foot of which is the water of a ditch or trench, in such manner as that the rows shall be gradually elevated above the surface of the water. When the plants have grown to a considerable size, let them be taken up; and the result shall be, that those nearest the water shall have no tap root, but evident marks of its having been destroyed by disease; the next in height shall have a small portion of tap root; and so on to the most elevated, which shall have the tap in a complete healthy state. These plants in their parts above ground, shall exhibit a vigour proportioned to the perfect state of the root, and consequently to their elevation from the water. Sometimes however, nature, with her usual compensative economy, gives either a new direction to the root, or gives the plant a capacity of receiving from the atmosphere, that nourishment which makes up for the deficiency from the earth, or those remedial fluids which counteract the baneful influence of excess of moisture; for, in many low situations, I have known the cotton trees to yield abundantly.

Before I conclude this part of my subject, I may observe, that a deficient nourishment of the cotton tree, after a long tract of very dry weather, produces an effect in many respects similar to blast. But this effect, in truth, is no more than similar; and the difference is made apparent by the supervention of moderate rains. Here there is no exhausted irritability, no positive hurtful power, but a subduction of the necessary supports of life: moderate nourishment gives renewed vigour to the plant, and enables it to yield abundantly. The period from July to November 1801, afforded a striking illustration of this; scarcely any rain fell during the whole of these months, whilst the chenille devoured the leaves, leaving the stem and branches completely striped until September, and very little cotton was produced. In November, moderate showers recovered the cotton trees; and the heavy rains of December, instead of injuring them as they did the preceding year, gave them a great addition of health and strength, and enabled them to produce most abundantly. This is proved by the cotton picked during these months; in October 7053lb. in November 13,826lb. in December 53,972lb. This was, in fact, among vegetables, a case correspondent to that of famine, or accumulated irritability among animals, so finely illustrated in the ingenious remarks of Dr Thornton on the state of the crew of Captain Bligh's boat, (*Med. Extracts*, vol. iii. part 3. sect. 44.)

In the consideration of the pathology of plants, we are much assisted by bearing in mind the analogy which may be perceived between the diseases of plants and those of animals,--a branch of agricultural knowledge of very high importance, but in which it must be confessed hitherto little progress hath been made. The causes, symptoms, and cure of both, come under the general principles of medicine; and by applying these principles, as they relate to the latter, to the former, we shall find an unexpected facility in the developement of the ratiocination on which their prevention and cure depend. Thus, if the disease of the plant proceeds from plethora, depletory means may go far to cure it; if the disease arises from direct debility, the gradual admission of stimuli, or of those means suitable to the nourishment of the plant, will effect the restoration of its vigour; but if, on the other hand, the disease is gangrene or a state of exhausted irritability, we must submit; and our exertion then must be directed to preserve the trunk and larger branches, and prepare them for a new growth, or a renovation of their vegetative powers at a future season, for the means of immediate recovery are not in our power. I have said, that the excess of the excitement of the cotton tree, proceeds from a redundancy of moisture or water; the cure therefore, is evidently the quick discharge of that water, by the enlargement of the sluices or outlets of the plantation, or by having, what is called in Demerary, a deep drainage. Should circumstances prevent this from being immediately effected, which often happens, owing chiefly to the nature of the soil, it is, at least, in the power of an active and judicious planter to prevent the recurrence of the evil. Besides the usual means of deepening the channel into the sea, and fencing the windward side of it against floating mud, and putting in larger kokers or flood-gates; there is another, which, without due attention to the operation of it, may be considered visionary, and that is a steam-engine so placed as to throw the water it raises over the front dam into the sea. The expence of purchasing constitutes the only objection of weight, and should that be got over, the efficiency of the remedy must stand confessed. Upon the whole, however, a secure and ample drainage should be the first object on a Demerary plantation, for it is by that almost alone that this species of blast can be prevented or cured.

The privation of moisture, and the destruction of the organs of exhalation and inhalation of the plant, the leaves, by the caterpillar, are great evils, but of infinitely less magnitude than the excess of moisture. They have their remedy. In situations where the continuity and level of surface are not interrupted, as is the case generally on the sea-coast of Demerary, beyond the cultivated grounds, a supply of fresh water may, by the exercise of a little industry, be at all times obtained. By carrying a small canal about a thousand roods into the interior country, where the surface is in its native state, covered by a thick coat of a spongy vegetable substance, (Pagass), at all times charged with fresh water, a constant flow of this most necessary article may be maintained, sufficient to irrigate the fields, and to supply the negroes with drink. An excellent man, and a good though speculative planter, Mr Post, exemplified the practicability of this resource in a most remarkable and most benevolent manner, in the very long dry seasons of 1801 and 1805. In the case before us, the usual method resorted to, is to admit a certain portion of salt water into the trenches, the effect of which is strongly to stimulate the cotton trees, and a general blow, or bursting of pods, often ensues; but this method requires so much judgment in the employment of it, as to render it very generally dangerous—too great a supply excites the trees to an effort which soon proves fatal to them. This, in fact, is a fine illustration in vegetables, of the doctrine of wasted excitability in animals; the result is precisely the same in both; for, to use the language of Brown, "no means of reproducing the healthy state, that is, the proper degree of excitement, is left, but the very circumstance that occasioned the waste, that is, already an excess of stimulant operation, not admitting of more stimulus."

It is unnecessary to offer any observations on the third state of disease of cotton trees, the subduction of excitement or gangrene, or what, in strict propriety of language, is blast or blight; it is a state truly irremediable. All that can be done, must be done in the way of prevention; and an attention to the means of curing the first state of disease, will in a great measure prevent this, viz. good drainage: for if the excess of excitement is prevented from taking place, or obviated should it take place, there will be the less danger from the sudden subduction of it.

Upon the whole, a judicious system of cotton planting, including the various operations of draining and cross-draining, if necessary; of levelling and open planting the land (squares of six feet); of taping, singling, and weeding, the young cotton fields; of weeding, pruning, and dressing, the old trees, on or before the first of June; of deepening and clearing the drains before the actual occurrence of the dry season in August; of providing as much as possible the means of irrigation in long tracts of aridity;—these, I say, together with a general attention to the course and succession of the seasons, and to the phases of the moon, will be the most certain means of preventing the various evils of plethora, debility, and gangrene, in the cotton trees, or curing them should they unhappily prevail.

Before I conclude, however, I may observe, that there is another species of blight which arises from lodging the seed in imperfectly drained land. This is a species peculiar to Demerary, and countries whose soil is naturally surcharged with water, but does not come precisely under the class of diseases occasioned by plethora and destruction of the sap root, although nearly allied to them. Cotton planters say that in such land, the plant is sickly from a *sour water* which remains in it until it be completely drained. They are not aware of the propriety of the expression; for the sickness of the plant, in truth, is produced by the basis of acidity. The water becomes decomposed, and the earth absorbs hydrogen, and the disengaged oxygen mixes with the atmosphere, and enters in the composition of the vegetable growing in the soil, which thus become superoxygenated, and perish from that cause.

A constant attendant on blast, or when the cotton has even a tendency to blast, is an insect, called by cotton planters the cotton bug. Thousands inhabit the pods when the plant is in a diseased state, and seem to contribute much to its destruction. I have reason to believe that this insect has not hitherto been correctly characterised. It is certain that Dr Brown has failed in doing so, and both he and Mr Hughes, the historiographer of Barbadoes, have confounded it with the moth and the bruchi, which are inhabitants of the cotton tree in any state. Dr Brown calls it a cotton fly, and distinguishes it thus, *Bruchas kermesinus maculis nigris notatis elitrarum extremis fuscis.* Although this description corresponds precisely with the natural appearance, figure, and form of the cotton bug, it certainly is by no means applicable to the bruchus; and when he adds, "the caterpillars of these flies are frequently pernicious to the cotton bushes, and often destroy whole fields of the most promising plants in a short time," he confounds it with the moth. The cotton bug is really a species of cimex, unnoticed by Linnæus, and belongs more particularly to the oblongi. It may be distinguished by the name of the plant it inhabits, (*C. Gossypioides*), and its character is that I have quoted from Brown. The young bugs are scarlet, and inhabit the blasted pods of cotton. The full grown bug is that described by Brown, and possesses (when bruised) all the offensive fœtid smell of the domestic bug (*C. Lutalarius.*)

Such is the natural history of the cotton, and its diseases, in as extended a form as our limits admit. We now shall conclude with a rapid sketch of its commercial history

Cotton was known to the ancients, and is particularly described by Pliny. We have not, however, been able to discover the mode of its manufacture in those early periods. The beauty of the substance, and its obvious applicability to many purposes, would no doubt excite a very early attention; but it was not until the wonderful facilities which were introduced into the spinning of the raw material, that it became an object of extensive cultivation by Europeans. In India, indeed, where the cheapness of labour always counterbalances, the necessity for much manual labour, it has been long cultivated and manufactured into muslins and calicoes, by the simple apparatus of the inhabitants. England boasts of having introduced the improvements in machinery which have rendered cotton an object of immense attention to Europeans. Ever since the West Indies have been settled by Europeans, it has been partially grown; but it was confined to few situations, as other colonial produce was more marketable. The British West India islands for a long time supplied nearly the whole of the British demand. About thirty years ago, the Dutch settlements on the coast of Guiana attracted the attention of cotton planters, and nearly at the same time the southern states of North America engaged in similar pursuits. Still more recently, the Brazilians and Spanish Americans have actively cultivated cotton; so that the quantity now produced in the western hemisphere, in Africa, the south of Europe, and in Asia, is incredibly great, and may be augmented in an indefinite proportion, provided that there was any market for it; but like every thing else for which there has been an unexampled demand, too much is produced, and its value has decreased in a corresponding ratio.

The East India cotton, the Pernambuco, the Sea Island (American) the Demerary, Berbice, and Surinam, are the cottons most valuable for the finer purposes. The West India island, the Bowed Georgia, and some kinds from the Levant and the East Indies, are fitted for coarser purposes. The quantities of cotton which have been consumed by the British manufacturer are enormously great, and have been gradually increasing; of which we may form some estimate, when we recollect, that the quantity in 1784 was perfectly insignificant, and that the estimated consumpt of the current year is about seventy millions of pounds.

The expence of cultivation varies very considerably in different situations, and it will be found to be most reasonable in India and in the Americas, while it will be seen to be greatest in the British colonies, owing to causes which we shall afterwards notice. In the British colonies, particularly in those captured from the Dutch, on the coast of Guiana, the capital vested in every acre of land devoted to the cultivation of cotton, (in this the actual price of the land, the slaves, buildings, &c. are included), amounts to about L. 150 sterling. Each acre, as has been shewn by an average of ten years, produces about 200 lbs. net of cotton. From averages taken from plantations, the expence merely of cultivation amounts to 7d. per lb. while the mercantile charges, including the duties, amount to about $7\frac{1}{2}$d. more on each pound; so that the whole expence on every pound of cotton is not less than 1s. $2\frac{1}{2}$d. The average prices from the year 1784 to the present time, have varied very much, having been at one time (in 1808) as high as 3s. and at another below the actual cost, which we have already shewn to be 1s. $2\frac{1}{2}$d. During the same periods, war duties have been imposed in very different proportions on different kinds of cotton. For a considerable part of it, American cotton paid a smaller duty than that grown in the British colonies. But our readers will form more accurate notions on this point by glancing over the subjoined Table.

Table of Duties on every 100 lbs. of Cotton, since first Imposed.

Period.	British.	North American in American bottoms.	Foreign generally.	Brazil in British ships.	Brazil in Brazil ships.
	s. d.	s. d.	s. d.	s. d.	s. d.
July 1799 ... September 1801	8 9	6 6	12 6		
May 1802 ... July 1803 ...	10 6	7 10	15 0		
July 1803 ... April 1805...	16 8	17 8	25 0		
April 1805... July 1808 ...	16 10	17 10	33 10		
July 1803 to the present time	16 10	20 5 or 21 $1\frac{1}{2}$	33 10 or 25 $3\frac{1}{2}$	16 10	25 2

These are the general rates, but more or less is paid according to the mode in which the cotton is imported. It is needless to enter into any details respecting the injustice which has been exercised towards the British cotton grower; but it may be well for us to point out, as rapidly as we can, the various oppressive restrictions, that increase the expence of his establishment far beyond that of any other cultivator of the same substance.

Before, however, we enter into this sketch, it may be well to give an outline of the expence of settling a cotton estate in Louisiana, which we have derived from an authentic and respectable source, and which will serve to render the contrast still more remarkable.

In Louisiana, 600 acres of land cost	L. 1575
30 slaves	2700
Oxen, horses, cows, and sheep	450
Total	L. 4725

These 30 slaves will cultivate 30,000 lbs. of cotton; which, if sold at $10\frac{4}{5}$d. per lb. will yield L. 1350.

The items of the annual expenditure are as follows:

Overseer, ...	L. 90 0 0
Carpenter, ...	67 10 0
Medical attendance, ...	9 0 0
Tools, ...	22 10 0
Clothing, &c.	67 10 0
Freight of crop to market, ...	22 10 0
Taxes, ...	5 12 6
Total, ...	L. 284 12 6

which deducted from L. 1350, gives a clear revenue of L. 1065; 7; 6 as a return for the original outlay of L. 4725.

The chief causes of the deteriorated condition of British cotton properties, are to be found in the nature of the connection which subsists between the colonies

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and Great Britain, which seems to have been established solely for the purpose of benefiting the latter: we do not deem it necessary to enter into argument on the subject, but we shall state facts which speak for themselves.

The monopoly both of the supplies and of the produce to the colonies, is one of the chief sources of the high expenditure in cultivating cotton in the British West India possessions. This, however, has been adopted with a view of enforcing the ends of the navigation laws, and therefore are not to be opposed. Every article of clothing, of luxury, and even of the first necessity, is derived from the united kingdoms; unless, indeed, under the most distressing circumstances, when the governors of the colonies are authorised to open the ports to American vessels during peace. But in general no permission is granted. Now every article of food in America may be procured at one half, or even a third of the sum it actually costs when brought from England. The monopoly of the produce also is disadvantageous to the British cotton grower, particularly in the time of war, when he is obliged to incur all the war charges without any reciprocal advantage, while if permitted to choose his own market, the supply would be regulated, and the price be in consequence rendered equal to the expenditure.

This then is the predominant cause of the expense of cotton plantations in British settlements; and unless it be regulated, the British planter can never enter into competition with the foreigner. We might, did our limits permit us, enter largely into the subsidiary causes; but it is impossible to do so, without exceeding the object of this work. (C. M.)

On the different Kinds and Qualities of Cotton.

Different kinds of cotton.

COTTON is now so extensively used, as the raw material of a most extensive and useful manufacture of cloths of many different kinds, that a short account of the different kinds imported into the British market, with remarks upon their respective qualities, and the estimation in which they are generally held by the manufacturers who use them, may perhaps be the most useful introduction to the account which we propose to give in this article, of the various stages of this most extensive and beneficial application of British industry.

Smyrna wool.

Smyrna Wool.—This kind of cotton wool was formerly imported from the Levant, in quantities proportioned to the trifling demand which then existed for it, and was almost the only kind then to be met with, excepting a few bags occasionally imported from the West Indies. It is now rarely to be met with, the price which it commands affording no encouragement to the importer to trade in it. This is little to be regretted, as it is short in the staple* and very weak in the fibre. Although soft and silky in appearance, therefore, it is neither well fitted to undergo the fatigue of the many processes to which cotton is subjected in the course of manufacture, nor does it produce an article of either beauty, strength, or durability when finished.

West India.

West India.—The cotton wool of the West Indies is various in quality, but is in general a strong coarse article, pretty long in the fibre, and sufficiently well adapted for the manufacture of the stouter and coarser fabrics of cloth, to which it is generally applied. It is totally unfit for the lighter and ornamental goods.

East India.

East India.—No great quantity of this has ever been imported into Europe; the company perhaps considering a great importation of the raw material as likely to prove injurious to their more lucrative traffic in finished goods. What has been imported is very various. That known by the name of Bourbon is generally of a very superior quality, both in strength and fineness. It is still the only wool used for yarn of the finest kinds. A coarser kind of wool is also sometimes brought from India, generally in large square matts or bales. It is fine, silky, and glossy in appearance; but is so very short and weak in the fibre as to be hardly capable of being spun.

South American.

South American.—The wool brought from the different settlements on the continent of South America, ranks higher in general estimation than any we have hitherto enumerated, excepting the Bourbon. The chief kinds are the Brazil, which is distinguished by the names of Pernambuco and Maranham, from the districts where it is produced. The Pernambuco wool is rather short in the fibre, white in the colour, and in quality is superior to any imported, the Bourbon and Georgia excepted. The Maranham is similar in quality, but inferior both in strength and cleanness to the Pernambuco.

Demerary.

Demerary.—Which is a fine white glossy wool, pretty long in the fibre, and generally very well cleaned and picked before packing. It forms a clean stout yarn, and is very fit for what is of a moderate fineness, but it is too long and coarse in the fibre for very fine yarn. The Cayenne cotton is not much imported. It is a strong clean white wool; but the fibre being of uncommon length, it is found difficult to card and spin by the modern process. The others, viz. Berbice, Surinam, &c. are of the same general description, but inferior to those mentioned, and pretty nearly on a level in quality and price with the West India wools.

Georgia.

Georgia.—It is not many years since the cultivation of cotton was introduced into Georgia and South Carolina. Its superior qualities, however, soon raised it to a very high rank in the estimation of the British manufacturers. The Georgia wool is not the produce of the common gossypium or cotton tree, but of a small shrub, which after two crops decays and is rooted out. The Georgia is called either Sea Island or Bowed. The first is decidedly superior to any known, the Bourbon excepted. The Bowed Georgia is a short fibred weak cotton, inferior even to the West India wool.

To the above short account of the mercantile estimation in which the different kinds of cotton wool usually brought into the British market are held, we need only add, that perhaps a common price-current list will be found the best criterion to which we can refer as the standard of their respective values. But this must also be taken cautiously, as the prices are often greatly affected by casual interruptions of the supply, either from failure of crops or political vicissitudes. The coarse wools from our own colonies do not of course suffer the same interruptions as those belonging to foreign powers; and in point of quantity these furnish by very far the greatest proportion of the supply, from being applied to the coarser and thicker fabrics, which not only require the greatest weight of stuff, but from their durability are consumed by the great mass of the people.

Besides the vegetable qualities of the wool, a considerable difference in its value arises from the mode in which it is prepared for the market by the cultivator. In the Dutch settlements, that patient and laborious care for which those people are so remarkable in all

* By the word *staple*, cotton dealers and manufacturers mean the fibre or hair of the cotton.

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their pursuits, is strikingly visible in the attention paid to picking their cotton. Hence the Demerary wool is generally considered worth perhaps ten or fifteen per cent. more, on account of the cleanness and uniformity of its quality, independent of its intrinsic value when compared with other cottons. It must be obvious, that the cleaning of cotton before it is packed, deserves, from the planter, a much greater portion of attention than it generally receives, when he considers, that the freight of much inferior stuff might be saved, and that he can command labour at a much cheaper rate than the British manufacturer, who must submit the cotton which he purchases to a very rigid and expensive examination, frequently abstracting from it one fourth of its weight before it is rendered fit for his purpose. That this may not be supposed overcharged, let us suppose a very common and not highly rated case.

One pound of Pernambuco wool costs . .	2s. 6d.
Picking 6d. per lb., 6 oz. waste 1s. . . .	1 6
	4s. 0d.

Clean cotton remaining 10 oz.; which, therefore, costs the manufacturer six shillings and four pence eight-tenths per lb. previous to all his subsequent operations, excepting a small deduction which he may obtain by selling the waste, or manufacturing it for some coarser purpose. Again, if we can suppose that the planter, from having his labour at a lower value, could have the same cotton picked for three pence per lb. with the same refuse or waste, and that he could sell it to the British manufacturer 20 per cent. lower than by the former calculation it actually costs him, he would receive five shillings and one penny per lb., saving upwards of one third of the freight and charges, and reserving his inferior cotton either for domestic uses or for traffic, as he found most advantageous. Simple as this statement is, much difficulty would, no doubt, occur in reducing it to practice; but the obvious absurdity of paying a high freight, and a war premium of insurance, for what is found totally unfit for use, must strike every person at first sight; and this hint is well worth the serious attention of those extensively interested in the prosperity and management of cotton plantations. The remark respecting the Dutch colonies is a sufficient proof, that there is nothing impracticable in it when care and attention are employed.

A general complaint has been made of the great room occupied on board ship, by the way in which cotton is packed in the bags, being merely trod down in the bags by the negroes employed on the different estates. To remedy this, compressing presses have been suggested as useful improvements, and a considerable number have been already ordered by West India merchants for the use of the planters. These presses, in shape, are not materially different from those used for the pressing of cloth in calenders, or that employed by printers and bookbinders for the compression of paper and books. The compression of cotton, besides the saving of room, must be advantageous to the cotton, in so far as it will prevent, in a great measure, that absorption of moisture of which it is so eminently susceptible, and by which it is so frequently damaged; but it will require rather more labour in beating to restore it again to a state fit for carding.

On the Cleaning and Picking of Cotton.

Cleaning, picking of cotton.

In the manufacture of cotton, the process first in point of order is the cleaning it from the seeds or gins. This process, more easily accomplished by hand than any other, and apparently the most simple, has, in experience, been found the most difficult of all to be accomplished by machinery.

It is of much importance, not only to the manufacturer, but also to the merchant; for by sending home the raw material, mixed with a large proportion of matter entirely useless, the expence of conveyance, already great from America, and still greater from the East Indies, is much increased. Could the cotton, therefore be cleaned to a certain degree abroad, without injury to its staple, it would be an evident saving to the merchant, and would lessen the labour, as well as the first cost to the manufacturer. For these reasons, the ingenuity of men has been excited to accomplish this desirable end.

How far they have been successful, we shall now endeavour to show, by describing a variety of methods which have been employed to clean the raw material, both by hand and by means of machinery.

Methods of Cleaning Cotton Abroad.

Methods of cleaning cotton abroad.

In the West Indies, and on the continent of America, what is called the roller-gin has been long used. It consists of a pair of fluted rollers, about $\frac{5}{8}$ths of an inch in diameter, and about nine inches long, the one being placed immediately over the other. These rollers usually receive their motion from the foot, by means of cranks and fly-wheels, somewhat similar to the movements of a common spinning wheel, or foot turning lathe.

The rollers draw on the cotton between them, and separate it from the seeds, for the diameter of the rollers is so small, that the gin cannot, when whole, be drawn in between them.

With one of these machines a negro will clean from 30 to 40 lbs. in a day; but after working it two days, he is commonly so much fatigued, that it becomes necessary for him to have a day or two to rest, before he is again fit for the same labour.

These machines are sometimes wrought by horses, but they are not so much approved of; because when the horse quickens his pace, the cotton is apt to be hurt by the rapid motion of the rollers. This objection, however, might be easily overcome by a mechanical contrivance, to prevent the rollers from moving too rapidly, however quickly the horse might go. The same may be said with regard to any other cattle mill.

This machine, when properly managed, performs its work in a very perfect manner, being found not at all injurious to the staple of the cotton. The great objection to it is, that the quantity which it will clean is very small; for this reason, in Georgia, it is used for the Sea Island cotton only, and other means have been adopted in order to save time.

The cotton called bowed Georgia, takes its name from a mode of cleaning cotton, in use probably long anterior to the invention of the machine we have mentioned. This was performed by means of the bow-string, which being raised by hand, and suddenly let go, struck upon the cotton with great force, and thereby served both to separate the gin and open the cotton, so as to render it more fit for the processes which follow the operation of cleaning. But this mode, whatever advantages it might possess in point of quality, has been abandoned for others better adapted to get through a quantity of work; and what is called bowed Georgia, has for a long time, in reality, been cleaned by means of a machine, distinguished by the name of a saw-gin.

This machine consists of a cylinder about the size of a weaver's beam, having, at equal distances upon it, wheels cut out like a saw. Hence the name of the machine.

Instead of these saws, the machine originally had wires like card-teeth; but these having been found to make what is called white nap on the cotton, the saws were substituted. These saws serve to pull the cotton through a grating, which has its openings so narrow, that the gins or seeds cannot get through them.

The grating is inclined to the horizon. Cotton is thrown upon it by the negro who attends the machine; the teeth of the saws pull through the cotton, whilst the gin rolls down the surface of the grating, and escapes by a spout in the side of the machine. Meanwhile, the cotton is thrown backwards by the centrifugal force of the motion of the cylinder, by another cylinder covered with brushes, moving with great velocity, and serving the double purpose of aiding the delivery of the cotton, and of cleaning the teeth.

This machine, although very expeditious, and not materially injurious to cotton of a short staple, is altogether unfit for cleaning long cotton; and is accordingly not used, as I have already mentioned, for the kind of Georgia cotton, known by the name of Sea Island.

One of these saw gins will clean about 3 cwt. per day.

It is worthy of remark, that when the Upland Georgia cotton was first brought to this market, it yielded a higher price by about 2d. per lb. when it was cleaned by the roller-gin; but, contrary to all expectation, it has been found, that for cleaning this species of cotton, the saw-gin is much better adapted; and the cotton done in this last way is now much preferred by those who understand the nature of spinning it. The saws separate the gin much more effectually than the rollers, and at the same time give it a kind of teasing, which is found highly beneficial. This fact is well worthy the attention of importers of Surat cotton, for to it the machine seems equally applicable.

Modes of Picking Cotton in Great Britain.

Modes of picking cotton in Britain.

Machinery has been applied in Britain in the cotton manufacture to a great extent, and has arrived at a degree of perfection almost incredible. Yet the simple process of picking has hitherto, in a great measure, defied every attempt to produce an effect equal to what is done by hand.

The method of picking by hand in this country, is to spread the cotton on a table, the upper part of which is formed of cords, and quite elastic. There it is beaten by slender rods. The effect of this process is somewhat similar to the bow-string, and most of the seeds fall through between the cords; those which may remain are afterwards taken out by the fingers.

This mode of cleaning cotton renders it fit for the finest purposes; for while it opens it thoroughly, and makes it perfectly clean, it does not break the staple. Machinery of various kinds, however, has been tried, in order, if possible, to lessen the expence of this process, some of which I shall now describe.

1st Machine. The cotton is laid on a cloth, which passes over two rollers; and these having a motion communicated to them, feed forward the cotton. This contrivance is called a feeding-cloth.

From the feeding-cloth the cotton is taken by a pair of rollers, toothed like a coarse rasp; these having a slow motion, and pressing the cotton between them, feed it forward to what was called the comb, consisting of a number of pikes or teeth, and, having a reciprocating motion, tears the cotton from the rollers. This part of the machine is now called the Devil.

This machine, however, tore the cotton in pieces, and was but little used, except in the spinning of coarse weft upon common jennies.

2d Machine. A feeding-cloth similar to that just described, and a pair of toothed, or sometimes fluted rollers, fed the cotton forward to a cylinder, covered all over with pikes or teeth, which produced an effect nearly similar to the comb; but the motion being circular, the machine, of course, was more simple and durable, and also, by its centrifugal force, served better to open the cotton. A grating helped to separate the motes. This machine was also sometimes called a devil, sometimes a picker.

It also, however, was evidently very imperfect, for which reason we think it unnecessary to describe it further.

3d Machine. In the "Repertory of Arts" may be seen a description of what is called a batting machine, which imitates remarkably well the motion of the rods used in batting by hand; but most of the motions of this machine being violent and suddenly reciprocating, it has a constant and rapid tendency to produce its own destruction. And however well it might answer in a cotton mill, where skilful mechanics are always at hand, it would soon become useless in the hands of common field labourers.

4th Machine. Another mode of cleaning cotton by machinery has been attended with a very considerable degree of success.

In appearance it somewhat resembles the second machine, having cylinders with teeth; but, in reality, it acts on quite different principles. The second machine operates principally by *tearing* the cotton from the feeding rollers; this by having it *laid on* the cylinders; and it produces its effects by the centrifugal force.

It was at Manchester, in the year 1797, that the then managing partner of the Rothsay Spinning Company saw a machine somewhat upon the construction above alluded to. It put on so fair an appearance, that he was induced to order one of them. The late Mr John Barton of Shudehill, Manchester, perhaps the most experienced cotton spinner at that time in England, was so obliging as to take charge of the making of it, and to try it in his mill previously to sending it off for Scotland. About the same time, he also ordered one of these machines for Mr White of the Culcreuch cotton works.

After getting the machines, Mr White, as well as the manager of the Rothsay works, was greatly disappointed; the grating was then made of wire, and they found it impossible to keep it from choking. Another evil was also, that the one cylinder *tore the cotton from the other.* It was rendered ropy, and was very much injured. These unpleasant circumstances gave them much uneasiness; but they persevered in their trials, and kept up a constant correspondence as to the results.

They found that a great improvement was made by raising the tops between the cylinders nearly to a straight line, and depressing the grating immediately below that part of the tops; and by allowing the front cylinder to throw the cotton on the back cylinder, instead of the back cylinder tearing it, by the back cylinder pulling it from the front cylinder.

About the same time, Mr White was so fortunate as to invent a new kind of grating of tin-plate, which

Cotton.

completely obviated all former objections to the grating.

These improvements were soon afterwards adopted at Manchester, and at some mills in Scotland.

It, however, occurred to the Rothsay manager, that an enlargement of the cylinders would be an improvement, by giving a greater extent for grating, as well as a greater space to throw the cotton by the centrifugal force. He accordingly had one made at Rothsay, with cylinders 5 feet in diameter, which fully answered his expectations. The cylinders of the machine which came from Manchester, were only, we think, about $3\frac{1}{2}$ or 4 feet diameter.

Machines, somewhat on the same principle, have been tried with the addition of fanners, the better to open the cotton, and to prepare it for carding; but we have not seen any that, upon the whole, answered so well as that which we have just described.

One of them was afterwards made for the Adelphi cotton works, Glasgow; and is still used for the whole of the cotton in that mill. It has been used for yarn as fine as 130 hanks per lb.; and takes out at an average about one oz of motes per lb. from the cotton.

From the rapid motion of the cotton over the grating, it is not only cleared of the gins, but by driving out all the dust, it greatly improved the colour of the cotton, which afterwards, before going to the cards, receives a slight hand picking, which takes out about a quarter of an ounce. The cylinders move at the rate of 242 revolutions per minute.

The cotton is commonly put twice through the machine, and it finishes about 140 lbs. in 7 hours; but this machine being only 22 inches wide, it is evident that, were it made wider, it would do a proportionate additional quantity of work.

It may also be proper to mention, that, at Rothsay, satisfactory experiments were made, the result of which was, that it did not at all injure the staple of the cotton.

Equal quantities of the same cotton were taken; one quantity was picked carefully by hand, the other was put a great number of times through the picking machine, and both were afterwards spun on the same frame into water twist. The number of threads of each kind which broke were carefully noted, and it was found, that the cotton which had been put through the machine, was as little liable to break as what had been done by hand,—a proof that the staple was not at all broken.

A gentleman from Demerary lately ordered some roller gins from Glasgow, upon a construction which promises to be a great improvement upon that machine, and will probably allow it to work at a much greater velocity than could hitherto been done, without injuring the cotton.

Description of the Roller Gin.

Description of the roller gin. Plate CCXII. Fig. 1.

The drawing, Fig. 1, Plate CCXII. represents the roller gin. The same letters refer to the same part on all the Figures. AB, CD, represents a pair of fluted rollers, commonly made of hard wood. They receive their motion from the foot by means of the cranks E, F, and the fly wheels G, H, somewhat in the same way as the common spinning wheel or foot turning lathe.

The negroe, who drives the machine, spreads the cotton on the cotton board. It is drawn in between the rollers, which serve to press out the seeds, and separate them from the cotton.

The seeds drop into the box I, and the cotton is delivered behind, and falls down the inclined board KL, thus cleared from the gins or seeds.

Description of the Saw Gin.

Description of the saw gin. Plate CCXII. Fig. 2.

ABCD is a roller about 9 inches diameter, which revolves in the direction marked by the arrow ↶. This cylinder consists of a number of circular saws S, S, S, &c. separated from each other by pieces of wood nearly one inch and a half in thickness.

Above the cylinder is placed a kind of hopper EFGH, into which the attendants throw the cotton, which falls upon a grating, up through which a small part of the saws projects.

The teeth of the saws lay hold of the wool, and pull it through the grating, whilst the seeds are by that means separated, and roll down the inclined surface of the grating, escaping by the spout IK. M is a cylindrical brush placed below the grating, which brush revolves, and by its motion serves to clear the teeth of the saws, and to throw the cotton clear of the cylinder, in the state in which it is ready to be packed for the home market.

Description of the Centrifugal Cotton Picker.

Description of the centrifugal cotton picker. Plate CCXII. Fig. 3.

The cotton is spread on the feeding cloth AB, which conducts it to the feeding rollers E, F.

The feeding rollers lay the cotton on the teeth of the front cylinder GH, and its centrifugal force strikes it against the tops I, K, and throws it upon the back cylinder MN.

The back cylinder moving with the same velocity, 242 revolutions per minute, acts on the tops in a similar manner, and conveys the cotton along part of the grating OPQRST, until it be laid hold of again by the front cylinder, and delivered into the receptacle UXYZ below the feeding frame.

In passing over the grating with such rapidity, the dust and gin are forced through the openings. From this circumstance, the machine not only takes out the gin, but greatly improves the colour of the cotton.

Description of an Improved Batting Machine.

Description of an improved batting machine.

A very considerable improvement has been recently made on the batting machine, with an account of which we shall conclude this part of the article. The idea of this improvement was taken from the thrashing mill. The cotton is fed through rollers, and struck by scutchers moving at a great velocity, which operation opens the cotton; at the same time it is blown by fanners, which serve further to open it, and to separate the lighter and finer parts, while the gin or seeds, sand, &c. are driven or fall through a harp or grating made of wire.

Plate CCXII. Fig. 4.

The cotton, as taken from the bag, is spread on the feeding-cloth AB, which conveys it forward to the feeding rollers. CD, EF are the scutchers, which, moving at a great velocity in the direction expressed by the arrow, strike and open the cotton as it is fed in by the rollers, while a strong current of air, produced by the motion of the fanners GHI, acts upon it. The gins, sand, &c. are driven through the circular harp LM, and fall on the angular harp NO. QR is a long harp or grating, which is level, and through which any remaining lumps or gins pass, while the cotton is blown forward to a small apartment or closet, from which it is from time to time removed. For fine spinning it is then ready to be picked by hand to take out any remaining moats, but for ordinary spinning it is taken immediately from the batting machine to the carding engine.

This improved batting machine not only saves much labour and expense, but from the manner in which the cotton is enclosed during the operation, much dust, films, &c. is prevented from escaping, which, as the process was formerly conducted, was most prejudicial to health.

The scutcher is 14 inches diameter, and makes from 1200 to 1400 revolutions per minute. The feeding rollers, one and three-fourth inches in diameter, go one revolution for 60 of scutchers. The fanners 22 inches diameter, same speed as the scutchers. The circular harp, under the scutchers, is one inch distant in the wires; all the other harps have their wires about three-eighths of an inch distant from each other. (O)

COTTON SPINNING.

Introduction.

The rapid progress of the cotton manufacture is unparalleled in the annals of trade. "In the year 1765, cotton, as an article of commerce, was scarcely known in this country."* "In 1782, the whole produce of the cotton manufacture did not exceed two millions sterling."†

"In 1801, the import of cotton wool into Britain was 42 millions of lbs. and the estimated value of the cotton manufacture 15 millions sterling. Such was the rapid increase of this trade to the end of the year 1801."‡

"Although in 1788 there were only 114 water mills in England, and nineteen in Scotland, yet the gross return from the raw material and labour exceeded seven millions sterling. It was estimated, that those establishments, when in full work, gave employment to 110,000 persons; that in all the subsequent stages of the manufacture, the number employed was estimated at 240,000, making an aggregate of 350,000 persons; and the quantity of raw material applied to the different branches of the manufacture, was computed at 22,600,000 lbs. But since the year 1788, the cotton manufacture has increased at least a three or four-fold ratio; the quantity of cotton manufacture being probably 80,000,000 lbs., the number of persons employed in all the branches about one million, and the gross value of the goods made above £20,000,000." §

The progress of the cotton manufacture, and its effects upon foreign traffic, as far as relates to Scotland, may be illustrated by the following statement of the imports of cotton into the Clyde at different periods:

	Bags.	lbs.
In 1775, there were imported	508 =	137,160
In 1790, ...	6509 =	1,757,504
And the average of six years, from 1804 to 1810, .	31,364 =	8,468,832
In 1812, ...	43,080 packages. ‖	

Thus we see, that little more than half a century has elapsed since the manufacture of cotton was scarcely

* See *Observations on the Cotton Trade of Great Britain*, published by the Board of the Cotton Trade, Glasgow, 2d February 1803.

† Ibid. ‡ Ibid.

§ See Wilson's *Survey of Renfrewshire*, published in 1812, page 258.

‖ The weekly quantity of cotton taken during 1812 for the supply of the spinning mills in England and Scotland, has been, from Liverpool 3861, London 1304, Glasgow 701, and all other ports 52; total 5918 bags, or 307,750 bags in the year; being an increase upon the supply to the trade in the last year of 13,950 bags, or 268 a week.

The following is a comparative view of the imports of cotton wool into the Clyde in 1811 and 1812; of the stocks estimated to remain on-hand at the close of each year; and the general average or medium price of each article.

Packages.	Imported in		Increase in 1812.	Decrease in 1812.	Stock remaining 31st December		Increase of stock in 1812.	Decrease of stock in 1812.
	1811.	1812.			1811.	1812.		
Bags, &c. .	42749	43080	331		16383	21639	5256	

Import of Cotton Wool into the Kingdom from the Year 1802.

	1802.	1803.	1804.	1805.	1806.	1807.	1808.	1809.	1810.	1811.	1812.
American, . .	107494	106831	104103	124279	124939	171267	37672	} 301107	339605	128192	93805
Brazil, ...	74720	76297	48588	51242	51034	18981	50442			118514	98704
East India, . .	8535	10296	3561	1983	7787	11409	12512	35764	79382	14646	2607
Other sorts, . .	90634	45474	86358	75116	77978	81010	67512	103511	92186	64879	66089
	281383	238898	242610	252620	261738	282678	168138	440382	561173	326231	261205

In order to explain and to contrast the effects of British mechanism with the simple labour of India, it is proper to explain the relative productive power of each, and the cost of cotton yarns, produced by each; comprehending that range of fineness, chiefly required for the eastern fabrics.

The quantity of mule spindles in Great Britain, appears, by actual survey, to be

4,200,000, Producing a quantity of cotton yarn, at least equal to that which can be spun in the same time by 4,200,000 persons in India; the wages of which are supposed at 2d. per day. In Britain

70,000 Persons would produce the same effect by machinery, at 20d. per day; consequently

1 Person in Britain is equal to

20 In India; but, in consequence of a more expensive apparatus, and various contingencies, it may be stated, that

1 Person is equal to 40 in India.

40 Multiplied by 2, is equal to 6s. 8d., which is the value of labour for spinning in India, to correspond with that of one person in Britain, or as 6s. 8d. to 1s, 8d.

Cotton Spinning.

known in this country. From this state of comparative insignificance, it has burst forth to be one of the most splendid branches of our national industry. In the following part of this article, we shall endeavour to trace the progress of an important department of this manufacture, (viz. the spinning,) and the causes which have contributed to raise it to its present state of importance.

HISTORY.

History.

The distaff and spindle appear to have been used for the purpose of spinning, by nations of the most remote antiquity; and it is worthy of observation, that, in all the countries which have been discovered by navigators for the last three centuries, these simple implements have been employed for the purpose of making yarn; and such is the mode still practised in India. Hence it has been inferred, that the same wants lead to the same means of relief. The use of the needle too, in all the above cases, is cited as a further proof of that opinion; and Pagan nations, unable to trace such useful contrivances to their true origin, attribute their invention to some one of their false deities. This simple machinery for spinning, was, in Britain, long ago nearly superseded by the well known domestic machine denominated the *one-thread wheel*. It continued in common use until about the middle of the last century, when the increase of the manufacture of cotton occasioned so great a demand for yarn, that a pause would naturally have ensued, and beyond which there could have been no advance, but with the slow and gradual increase of population. But as the demand for cotton goods increased, various contrivances were thought of for expediting the manufacture, and several attempts were made, but all with equal want of success, until the invention of the Jenny in 1767, by Richard Hargreaves, a weaver in Lancashire, a plain industrious man, but illiterate, and possessed of little mechanical skill. The invention is said to have been suggested by the accident of a spinning wheel being overturned, and seeing it continue in motion after its fall. Among his first attempts, he made a very rude machine containing 8 spindles, turned by bands from an horizontal wheel.

The jenny invented.

The popular prejudice being raised against him, he found it prudent to leave Lancashire, but he had previously constructed machines of from 12 to 16 spindles. He removed to Nottingham, and after assisting various persons in the construction of machinery, he died in poverty, ill requited by his employers, and little known to the country which reaped the important fruits of his discovery. While employed in Nottingham, a serious affray took place in opposition to the new machines, in which Hargreaves and others are said to have been severely wounded.

Various alterations were afterwards made on the original machine; the vertical was substituted for the horizontal wheel, which, with other improvements, rendered the jenny a much more commodious machine. It was enlarged in its dimensions, and made to contain twenty, thirty, and even eighty spindles; and although at first it met with determined opposition, yet it soon spread rapidly over the country; and it is worthy of observation, that those who were most strenuous in opposing it, were the first to avail themselves of its advantages.

Cotton Spinning.

Another improvement is also ascribed to Hargreaves. He is said to have been the inventor of *stock-cards*, which succeeded the hand-cards. This improvement enabled one person to perform double the work, and with more ease than could be done by the former method. This improved mode of carding consisted in applying several cards to the same stock, and suspending the upper stock by a rope passing over a pulley, having a counterpoise to the otherwise unmanageable weight of the stock.

Stock cards.

This contrivance was soon succeeded by the cylinder-cards, or carding engine. It seems uncertain who was the inventor of this valuable machine; but it is known, that the father of the present Sir Robert Peel was among the first who employed it, having, at Blackburn, as early as the year 1762, assisted by Hargreaves, erected a carding engine with cylinders; but this machine had no contrivance for stripping off the carded cotton. This operation was performed by women with hand-cards.

Carding engine.

We come now to mention by far the most important improvement in cotton-spinning; and indeed, if the steam-engine be excepted, we do not know any mechanical invention that has made such an amazing addition to the activity, industry, and opulence of this island, as the invention of Mr Arkwright for spinning by water, where dead matter is made successfully to imitate the human finger, directed by the unceasing attention of the eye.

Arkwright's water spinning frame.

Soon after the invention of the jenny in 1769, Arkwright brought forward his improvement in spinning, in which he had long been laboriously engaged.

Of this distinguished character we have already given some account, (see Arkwright.) We may, however, mention here, that he was born in an humble rank, and the youngest of thirteen children, and was a native of Preston, in Lancashire. The difficulties with which he had to combat, before he could bring his machine into use, even after its construction was sufficiently perfect to demonstrate its value, would have disheartened any but the most ardent genius. Some doubts have been entertained of the justice of his claims to the first ideas of the improvement; but it is beyond all doubt, that he was the first person who rendered it of practical utility, and by that means he was raised from one of the most humble occupations in society to affluence and fame.

The important and essential part of his improvement, by which the form of the cotton is so wonderfully changed, and to which all the rest of the process is subservient, and Arkwright's chief invention, is the *substitution* of machinery for the human finger. This machinery consisted of a peculiar application of rollers. He is said to have taken the idea of this improvement from accidentally seeing a red-hot iron bar elongated, by being passed between rollers; and although there be no strict mechanical analogy between this process and that of his

It is therefore evident, that one spinner by machinery in Britain will produce yarn at one-fourth of the price that it costs for the same quantity of workmanship in India, supposing the wages of the former to be 1s. 8d. and the latter to be 2d. per day; and reckoning the mean price of cotton wool, in Britain, at 2s. 6d. and in India at 5d., the cost of labour and materials united, would be less, upon an average, than one half; we shall consequently be able to meet competition in the eastern markets, either in yarns or in cloth, of which they form the principle constituent value.

Very important discoveries and improvements have, doubtless, been made in weaving, dyeing, printing, and bleaching; and particularly for certain operations and descriptions of cloth; but taken in the gross, the amount will bear but an inferior proportion to the economy introduced by spinning, upon which both invention and exertion have been upon the rack for the last thirty years, and a real capital vested in building and machinery of from eight to ten millions sterling.

Cotton Spinning.

improvement in spinning, yet from this hint being pursued arose, if we are rightly informed, an invention which, in its consequences, as a source of individual and national wealth, is without example.

Arkwright's water-spinning frame.

As already noticed, the effect of Mr Arkwright's application of rollers was precisely the same operation which the spinner performs with the finger and thumb; and the adaptation of this simple and beautiful contrivance to the spindle and fly of the common domestic flax-wheel produced what is called the *water-spinning frame,* the machine for which Mr Arkwright obtained his *first* patent, and on which was founded all his subsequent improvements.

But a considerable time elapsed before this patent was obtained, his circumstances not permitting him to commence business on his own account, and no person seemed willing to hazard capital in the undertaking. At length, however, he was so fortunate, as to secure the co-operation of some persons, who had sufficient discernment to see the merit of the invention, and he consequently obtained his first patent for spinning *by means of rollers* in the year 1769. His first mill was erected at Nottingham. It was worked by horses, but this mode of working being found too expensive, a larger mill driven by water was erected in 1771, at Cromford in Derbyshire. At this place he principally resided during the remainder of his life. In the year 1772, his patent right was contested; but he obtained a verdict in his favour, and enjoyed the patent to the end of its term.

The essential part of Mr Arkwright's invention being entirely new, he applied it with the happiest success in various forms, in several of the stages of the *preparation* of the raw material for the spinning; and soon after the erection of his mill at Cromford, he made many ingenious improvements in the mode of preparing the cotton; for all of which inventions he obtained a patent in 1775. But after reiterated contests with rival manufacturers in the year 1785, the Court of King's Bench cancelled this patent, on the ground of his not being the original inventor.

The contests above alluded to related chiefly to the operation of *carding,* which was now brought to a state of great perfection. We already mentioned, that the cotton was at first stripped from Mr Peel's machine by hand. Afterwards, this operation was performed by a roller, having tin plates like the floats of a water-wheel. This was, however, a very rude method. Mr Arkwright substituted a comb of metal, moved rapidly in a perpendicular direction by a crank; and in order to produce in the finishing carding a *continued fleece,* he introduced narrow cards, termed fillets, wound, in a spiral form, round one of the cylinders of the machine.

This operation of combing off the cotton in a continued fleece, and gradually contracting it into a narrow ribband, flattened between rollers, and delivered in the form of a uniform carding, is allowed to be one of the most striking and beautiful in the whole process of cotton-spinning. Mr Arkwright's right to the invention of the crank and comb was disputed in the last hearing of his cause. His claim, however, to the spiral cards, which produce the *continued carding,* has never been disputed.

That all these inventions and improvements should have been the production of an individual without education, or any previous mechanical knowledge or experience, is most extraordinary. Yet he was engaged at the same time in many other concerns, arising from the peculiarity of his circumstances. While he was extending the business on a large scale, he was introducing into every department of it a system of order and cleanliness, till then unknown in any manufacture. And all these exertions, too, were made when he was suffering under an oppressive disorder, which at last terminated his life.

Having now brought our history of Mr Arkwright's improvements to a conclusion, it may be proper to mention, that, notwithstanding the measures that were formerly taken to convince the labouring class of their folly and injustice in opposing improvements, a third and more numerous mob assembled in 1779, by which all the machinery for spinning by power, and all the jennies above a certain size, within eight or ten miles of Blackburn, were destroyed. These and similar disturbances in other parts of the country retarded, but could not stop the progress of the manufacture.

Water-twist.

The yarn produced by Sir Richard Arkwright's system of spinning is denominated *water-twist;* and from its strength and wiry smoothness, was found peculiarly applicable to the longitudinal part of webs, called *warp,* whilst the yarn produced by the jenny of Hargreaves, from its woolly fulness and softness, was better adapted for the *woof* or *weft* of coarse goods. These systems of Hargreaves and of Arkwright, for some years after their introduction, produced (with the exception of the small quantity that would be spun on the one-thread wheel) the whole of the cotton, twist and weft, used in the kingdom. But during the term of Sir Richard Arkwright's first patent, a *third* system of spinning by machines called *mules* was invented, which has almost entirely superseded that of Hargreaves, and has even in part superseded the mode of spinning invented by Arkwright. We say *spinning,* because his mode of *preparation* (which expression includes carding, *drawing,* and *roving*) is retained in *mule spinning,* and indeed the essential part of his system, *the rollers producing the effect of the finger and thumb.* On the application of this part of the system to the jenny of Hargreaves, the merits of the third *mode* of spinning (by the mule) in a great measure depends. Its utility has, however, been very great, and the variety of *qualities* of yarn produced by it is much greater than is possible by any of the former modes, at the same time that much finer yarn has been spun in this way than was before practicable. As an instance, we may mention that one pound of fine cotton has been spun on the mule into 350 hanks, each hank measuring 840 yards, and forming together a thread 167 miles in length.

Spinning machines called mules invented.

The *mule* seems to have taken its name from having been the offspring of the two machines in use at the time of its invention. This compound machine was invented by Mr Samuel Crompton, formerly of Hall in the wood near Bolton, in Lancashire, a person of very great ingenuity, and to whom the public is indebted for many other valuable improvements in the cotton manufacture. He also seems to have laboured under many disadvantages in his outset, as may be inferred from the following extract of a letter from him to the writer of this article: " In regard to the mule, the date of its being first completed was in the year 1779. At the end of the following year, I was under the necessity of making it public or destroying it, as it was not in my power to keep it and work it, and to destroy it was too painful a task, having been $4\frac{1}{2}$ years at least, wherein every moment of time and power of mind, as well as expence which my other employ would permit, were devoted

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to this one end, the having good yarn to weave, so that destroy it I could not." We have the satisfaction to observe, that parliament lately voted him a sum of money as a reward for his invention.

The mule was for many years worked by hand only, the variety of movements rendering it difficult to accomplish the working of it by the power of water or of steam sufficiently simple to be of common use.

Working mules by power.

Mr William Kelly at Lanark in Scotland, early obtained a patent for a mode of working this machine by power; but it was not until a considerable time afterwards that power was generally adopted. The plans which were tried were various, and the improvement progressive. One happy consequence of this improvement has been experienced,—the spinners are found now to enjoy better health than they did when they had to labour hard, while they breathed in warm and confined apartments, and on the whole, the working of mules by power may be considered as an epoch in the history of the cotton manufacture.

Throstle.

Of late years a modification of the water-spinning-frame, called the *throstle*, has come much into use for spinning *twist*. Its principles are, however, exactly the same as Arkwright's machine. Although the construction be somewhat more simple, and the cost less, yet it is in other respects not so perfect; and as we have elsewhere observed, (See Arkwright,) it is remarkable that since the time of Arkwright, no real improvement has been made in the construction of the water-spinning-frame.

Cotton spinning by machinery introduced into Scotland.

Arkwright's mechanism for preparing and spinning cotton had not been long in use in England, when it began to attract the attention of the traders in Scotland, who soon attempted to draw what was then, to many, a most lucrative branch of manufacture to Scotland. But it is difficult to plant a manufacture in a new country, even where there is no secret in the process; and the difficulty was still greater in this instance, where pains were taken to keep the business involved in mystery. Many who had been employed in the works of Arkwright left his service, pretending to a knowledge of the business, which they were very far from possessing, and those men were for a time eagerly sought after by new adventurers in the manufacture in both kingdoms; but in most cases these adventurers were no gainers by the acquisition. This may be easily conceived when we consider how very little a great proportion of the people now employed in our cotton mills know, and how much less they can communicate, of the construction of the machinery, or the general system of the business. If such be the case at present, what must it have been at the period of which we are speaking, and among men very deficient in the simplest branches of education?

Cotton mills erected in Scotland.

Notwithstanding these obstructions, however, several establishments were soon formed in Scotland. We have reason to believe, that the first cotton spun by water in this kingdom, was in the island of Bute, in what had been a lint mill, and was afterwards for some time the corn mill of Rothsay. But this was only by way of trial, and before the completion of the larger cotton mill. Nearly about the same period, cotton was spun at Pennycuick mills near Edinburgh, and also about the same time, viz. in the year 1780, the mill of Barrhead, in the parish of Neilston, was completed. Soon afterwards that of Bushby, in the parish of Mearns, and in the year 1782, a large mill of six stories was erected at Johnston in the parish of Paisley.* This was the first extensive establishment in Renfrewshire, and there is reason to think it was the first in Scotland which was productive of much profit to the proprietors. It was originally managed by people from England, but they proved of the description to which we have above alluded, and the proprietors were in all probability indebted to the discernment, perseverance, and mechanical genius of Mr Robert Burns, a native of Paisley, for rescuing the concern from ruin, and rendering the business a source of affluence.

We have already spoken (article Arkwright) of the establishment of Mr Dale's extensive works at Lanark, in which concern Mr Arkwright himself was for a time a partner. It is needless to enter further into the detail; suffice it to say, that in Renfrewshire alone, the number of cotton mills are now about 41, containing 237,000 mule spindles and 28,500 spindles for water-twist.† Besides the many extensive establishments in Lanarkshire, (which includes Glasgow,) and others in the counties of Ayr, Perth, and Aberdeen.

The working of mules *by power* seems to have originated in Scotland; and it is ascertained that one great desideratum in cotton-spinning, a machine for cleaning and opening the raw material, was first brought to its present degree of perfection in that part of the island. This is the most important improvement that has been made in the process for many years; and, we are informed, was first accomplished at Johnston, in the works of Messrs G. Houston and company, by Mr Peter Cooper, millwright.

GENERAL DESCRIPTION.

General description.

Having said thus much respecting the history of cotton-spinning, it will now be proper to give some description of the operations which cotton undergoes in its passage from the raw material to the state of yarn. It would require volumes to describe these operations in a complete manner, but our limits will only permit such an outline as may enable the reader to form some general idea of the subject.

The modes of producing yarn in the manufacture of cotton, as now conducted, may be considered as dividing into the following branches.

1. Jenny Spinning.
2. Water Spinning.
3. Mule Spinning.

The mechanical operations which cotton undergoes in these three modes of spinning are various, according to the purpose to which the yarn is to be applied. These operations may be resolved into the following elements: 1st, *Batting*. 2d, *Carding*. 3d, *Stretching*. 4th, *Plying*, (or as it is sometimes, though perhaps improperly called,) *doubling*. 5th, *Drawing*, and 6th, *Twisting*.

Jenny spinning employs only the 1st, 2d, 3d, and 6th, of these elementary processes. *Water spinning* employs them all excepting the 3d, (stretching,) while *mule spinning* employs the whole six.

These elementary processes will be better illustrated as they occur, than by attempting to give in this place abstract definitions of them, we shall therefore proceed to consider the first of the above stated branches of spinning.

* See Wilson's *Agricultural Report of Renfrewshire*, p. 249.   † Ibid.

Cotton Spinning.

I. Of Jenny Spinning.

Jenny spinning.

The jenny, in its manner of action, resembles the ancient spinning with the distaff and spindle, but is so contrived that one person works a number of spindles at once. We have seen that it was the earliest improvement on spinning after the *one-thread wheel,* and was the invention of Richard Hargreaves, weaver in Lancashire, in the year 1767.

The jenny continued long in use for producing *woof* or *weft* after the introduction of Arkwright's mode of spinning, which last was employed in producing *warps.* But as the *jenny* is now almost entirely superseded by the *mule,* we shall be very brief in our description of the machinery and operations, which come under this branch of spinning.

Batting. In another place, (see page 279, &c.), we have spoken of the various modes of cleaning cotton, which come under the *elementary process* denominated *batting.* For *jenny spinning,* it is next soaped, in order to make it more easily stretched in the roving and spinning. The soaping is performed by immersing the cotton in a solution of soap in water. It is next put into a screw press, and afterwards dried in a stove.

Carding.

Carding. Carding is the *second elementary process.* The card is a kind of brush made with wire, stuck through a sheet of leather, the wires being inclined one way at a certain angle. By this process the cotton is further opened, and the knotty parts disentangled, so as to form the whole into a uniform fleece.

We already mentioned that hand cards first, and stock cards afterwards, were employed before the invention of the cylinder cards. See Card *Manufacture.*

The carding machine, which has long been employed in this branch of spinning, consists of two larger and two smaller cylinders, and a number of rollers all covered with sheets or fillets of leather, containing the card teeth, similar to those of common hand cards. The larger cylinders move with considerable velocity; and the smallest ones go slowest.

Feeding-cloth. At one end of the machine is what is called the *feeding-cloth,* which, by means of rollers and pullies, receives a constant uniform motion. The cotton is weighed in equal portions, and spread on equal lengths marked on the cloth, which, by its motion, conducts the cotton to the first large cylinder, the teeth of which immediately lay hold of it. It is again taken off and laid on again by the rollers called *urchins.* It proceeds to the first small cylinder, and so on, till it passes to the last small cylinder called the *doffer.* The *doffer* is cleared by means of a steel comb, which receives an alternate motion from a crank. This contrivance, as already mentioned, is one of the most ingenious in cotton-spinning, and which we shall afterwards more particularly describe. The little fleeces taken off by the comb fall in between a smooth cylinder, having several very small projections on its surface, and a fluted arc, which serves to form the fleeces into little rolls about the size of candles. These rolls fall in regular succession on a moving cloth similar to the *feeding-cloth,* and they are in that state ready to be conveyed to the next operation called the roving.

Roving or Stubbing.

Roving. The roving is performed on similar principles to the spinning jenny, on a machine called a billy, containing generally about 36 spindles, which are driven by means of bands from a cylinder, which receives its motion from a vertical fly wheel driven by hand at one end of the machine.

This machine has a feeding-cloth on the side next the carding engine. Children are employed to lift the rolls or *rowans* from the carding engine, and unite them on the *feeding-cloth,* so as to form as many rolls as there are spindles in the machine. In order to *stretch* out these rolls, after a certain number of revolutions of a roller, the feeding-cloth stops, and the rolls are laid hold of by two horizontal pieces of wood the breadth of the machine, (which we may call the clasps,) which, when pressed together, clasp the rolls in imitation of the finger and thumb on the old *one-spindle* machine; from these pieces of wood the rolls pass to the spindles, which are disposed on a moveable carriage, which is made to recede, and by that means extends the rolls, reducing them to the proper size of the roving. This is the third elementary operation which we have denominated *stretching,* and the first time that it occurs. It is carefully to be distinguished from the fifth, viz. *drawing,* which is performed by means of rollers, but which does not occur in jenny spinning. This extended roving receiving a small degree of twine, is built on the spindles in the form of a cone by means of levers and wires, in doing which the carriage is returned to its former situation. These cones are called *cops,* and when made as large as the distances of the spindles admit, are taken off the spindles, and are ready to be spun on the jenny. The *twist,* which the roving here receives, is the first occurrence of the sixth elementary process, which is obviously essential to every mode of spinning. Stretching. Twisting.

The Jenny.

The jenny. The *jenny* is a machine, similar in its *operation* to the *roving billy,* but differs from it in *construction* in this respect, that the *clasp* is attached to the carriage, while the spindles are disposed in the rails of the frame which remain at rest. The drawing out of the clasp stretches the roves so as to reduce them into the size proper for the yarn; at the same time the spindles twine it. During the return of the carriage, the yarn is built on the spindles by levers and wires, and formed like the rovings into cops. It is wrought with the hand by one grown up person, assisted by a boy or girl, called a *piecer,* in order to mend such threads as break. The yarn, when taken off the spindles, is sometimes reeled, but more frequently given to the weaver in cops, who has it wound on the *bobbins* or *pirns* preparatory to being placed in the shuttle.

Common jenny yarn is now but little used, excepting for the woof or weft of calicoes. For this purpose, however, it is more esteemed than what is spun on mules, as it gives the cloth a more full and rich appearance.

II. Of Water Spinning.

Of Water spinning. The second method of spinning is denominated *water-spinning.* It received this name from being the first spinning done by a water wheel, and was the invention of Sir R. Arkwright.

Carding.

Carding. After the cotton is picked, the usual process is to card it first by a carding machine, called a *breaker,* and a second time on another, called a *finisher.*

The *breaker* consists of a larger and smaller cylinder.

The larger, or *main cylinder*, is covered with sheet cards, and moves at a considerable velocity; the lesser, or *doffing cylinder*, is covered with a spiral fillet of card wound round it, and moves slowly. These cylinders revolve in opposite directions, and nearly in contact with each other. Over the main cylinder is a kind of arch covered with cards at rest, called the *top cards*. The cotton is fed by means of rollers into the main cylinder. The main cylinder lays it on the *doffing* cylinder, from which it is combed, (as already mentioned of the carding for jenny spinning,) and in an uniform fleece is wound round a cylinder, or sometimes, instead of it, on a perpetual cloth. After this cylinder or cloth has made a certain number of revolutions, and thereby plying or doubling, (the fourth elementary process,) the cotton is broken off, and is in that state (called a lap) ready to be carried to the *finisher*.

Plying.

The *finisher* is similar to the *breaker*, only that the fleece, instead of forming a *lap*, is gradually brought into a narrow *band* or *sliver*, and is compressed by a pair of rollers, which deliver it into a tin can, which is afterwards removed to the drawing frame.

The Drawing-frame.

Drawing frame.

In this machine, *drawing*, (the fifth elementary process,) first occurs. Drawing is a curious contrivance, and is the ground work or principle of Arkwright's invention, for it is used in the *roving* and *spinning* as well as in the *drawing frame*. It is an imitation of what is done by the finger and thumb in spinning by hand, and is performed by means of two pair of rollers. The upper roller of the first pair is covered with leather, which being an elastic substance, is pressed, by means of a spring or weight. The lower roller, made of metal, is fluted, in order to keep a firm hold of the fibres of the cotton. Another similar pair of rollers are placed near to those we have been describing. The second pair, moving at a greater velocity, pull the fibres of the cotton from the first pair of rollers. If the surface of the last pair move at twice or thrice the velocity of the first pair, the cotton will be drawn twice or thrice finer than it was. This relative velocity is called the *draught* of the machine. This mechanism being understood, it will be easy to conceive the nature of the operation of the *drawing frame*. Several of the narrow ribbands or *slivers* from the cards, (or as they are sometimes termed *card ends*) by being passed through a system of rollers, are thereby reduced in size. By means of a detached single pair of rollers, the reduced ribbands are united into one sliver.

These operations of drawing and plying serve to equalize the body of cotton, and to bring its fibres more on end, which, in the *card-ends*, were crossed in all directions. These slivers are again combined and drawn out, so that one *sliver* of the finisher drawing contains many plies of card-ends. Hitherto the cotton has got no twist, but is received into moveable tin cans or canisters, similar to those used for receiving the cotton from the cards; sometimes, however, it does receive a small degree of twist in the finishing drawing.

Roving.

Roving.

The roving is a process similar to the drawing, only that it always communicates a degree of twist to the cotton. The roves are wound up on bobbins, and are then ready to be spun. The operation of *winding* is in some cases performed by hand, and in others by power.

Spinning.

Spinning.

The bobbins containing the rove are placed on the back part of the spinning-frame. The spinning is little more than a repetition of the process gone through in making the rovings.

The *spinning-frame* contains rollers similar to those of the *drawing* and roving frames, which serve to extend the rove, and reduce it to the required fineness; at the same time it is twisted by means of a spindle, but of a different kind from that of the common jenny.

Previously to the year 1767, spinning was performed on the domestic one-thread wheel, of which there were two kinds. The *first*, which had a simple spindle, required the material to be previously carded; and, as we have seen, the common jenny was founded upon this simple machine.

The *second* was the flax-wheel, which was used for other substances, that, from their nature, but more particularly from the length of staple, did not admit of carding, but were prepared by an operation resembling *combing*. The spindle of this machine had a bobbin and fly, which served to wind up the yarn as fast as it was spun. This last kind of spindle is that which was adopted by Arkwright in his mode of spinning. When the bobbins are full, they are taken off the spindles in order to be reeled.

The Throstle.

The throstle.

A machine called the throstle has of late years come much into use for spinning water-twist. Its principles are the same as those of the water-frame, but it has fewer parts. In the water-frame, every *head*, as it is called, (of four or six spindles) may be stopped separately; whereas, in the throstle, the whole rollers and spindles on each side of the machine are connected.

Reeling.

Reeling.

The reeling is performed on a machine consisting of six wooden rails parallel to the axis, which winds a considerable number of threads at once from the bobbins. It is one yard and a half in circumference, and is of such a length as to give room for the hanks without danger of the threads getting foul of each other. At one end of the axis is wheel-work, constructed to strike a check at every 80 revolutions of the reel. These 80 revolutions form a *ley*, or *rap*, of 120 yards in length, and seven of these *leys* constitute a hank, which measures 840 yards.

The size of yarn is denominated from the number of such hanks of 840 yards as will weigh one pound. Thus what is called yarn No. 60, contains 60 hanks in each pound weight. This measure is now in use for cotton yarn in Scotland as well as in England; but the old Scotch reel is different, 18 English hanks being reckoned nearly equal to a Scotch spynal.

The size of the yarn is ascertained by weighing the hanks on an instrument called a *quadrant*, and each size is put up separately in bundles of 10 pounds weight. These bundles, by means of the *bundling press*, are neatly formed into cubical packages, which being put up in paper are ready for the market.

Water twist is generally spun hard, and in that case is used for purposes requiring much strength, such as the warps of fustains, calicoes, &c. A softer kind of *water twist*, which is very uniform and even in its thread,

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is used, when doubled and slightly twined, for making stockings, and is denominated stocking yarn. The lower numbers are sometimes used single, and are called double-spun. Water twist is used of all sizes from No. 6. to No. 60.

III. Of Mule Spinning.

Of Mule spinning.

The spinning machine called the *mule*, most probably derived its name from partaking of the nature both of the *jenny* and of the *water-frame*. The invention of the mule may be considered as a new æra in the history of cotton spinning. The combination of the jenny with Sir R. Arkwright's invention of *drawing by rollers*, forms a method superior to both, at least for fine goods, and much finer yarn has been produced by the mule than is practicable by either of the other methods.

Preparation.

The *preparation* for mule spinning is the same, or similar to that for water spinning, only that, in order to reduce the rovings for fine yarn to a small enough size, the cotton generally passes through a machine called a *stretching frame*, which is constructed nearly like a *mule*, and which will be more easily explained after describing that machine. The rovings taken off the spindles of the *stretching frame* are formed into *cops*, and these rovings so formed are placed in the mule, in order to be spun.

The mule consists of a system of rollers similar to the *spinning-frame*, but coupled together instead of having every four or six threads in separate *heads*, by means of which the rove is drawn, and received on spindles revolving like those of the jenny. The carriage on which the spindles are disposed is moveable, and recedes from the rollers as the thread is delivered. After a certain quantity of the roving is thus given out by the rollers, they are stopped, but the carriage continues to recede a certain distance further, the spindles continuing in motion, and by that means stretches the thread still finer. This last part of the operation resembles the effect produced by the jenny. The building of the yarn on the spindles, in the form of cops, during the return of the carriage, is performed in a manner similar to the forming of the cops in the roving billy.

Mules are various in their number of spindles, but since they have been moved by power, 300 spindles in each is not uncommon. Two machines are usually attended by one man assisted by children.

The *stretching frame* will now be more easily understood. It is like a mule, but the spindles are placed at a greater distance from one another. But the name *stretching frame* seems improper, for it merely reduces the rove by *drawing* it by the rollers, for the carriage recedes at the same rate as the rollers deliver the roves without *stretching* it. The mule, we have seen, does *stretch* the thread after the rollers have ceased to move, and generally to a certain degree even during their motion.

Description of a New Diagonal Mule.

New diagonal mule.

The astonishing reduction of labour, which has been effected by the introduction and improvement of the various kinds of machinery for spinning cotton yarn, is certainly the primary cause of the incredible extension to which that manufacture has been carried; and the competition among those who have embarked in the business, added to the exclusion from foreign markets, may be regarded as the reasons of the corresponding reduction of the prices of all kinds of manufactured cotton goods.

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New diagonal mule.

The principal difficulty which the spinning trade has now to contend with, is the very large capital which it is necessary to sink in buildings and machinery, before an establishment can be formed capable of contending in the market with those previously erected. To counteract this impediment, in some degree, is the object of the invention, or rather improvement, which is here suggested for the consideration of those interested, or who wish to interest themselves in this manufacture.

As the alteration from the established practice affects no principle, upon which the quality of cotton yarn *does* or *can* depend, there is no reason to hope that the article manufactured in this way will be improved, and as little cause to fear that it will be deteriorated by the change. A reduction of the amount of the sunk capital, necessary to put a certain number of spindles in motion, and to manufacture a certain quantity of cotton yarn, of a quality equal to what has been hitherto spun, are the only objects in contemplation.

The expence of erecting a mill or manufactory may be divided into three classes, upon each of which, it is demonstrable, that the use of machinery upon this plan would save much expence in the erection, the necessary repairing, and the working. These are,

1*st*, The expence of erecting suitable buildings to carry on the business.

2*dly*, That of procuring adequate power, whether water or steam, to put the machinery in motion.

And, 3*dly*, The expence of the machinery itself.

In order to establish these points to the satisfaction of our readers, especially those conversant with the business, it will be proper to describe the proposed machine, referring to Plate CCXII. for the illustration, and then to deduce, from the nature of its construction and operation, a proof of its capability of producing yarn equal to any now spun, with a great reduction on each of the three heads which have been premised. Plate CCXII.

Fig. 5. is a horizontal plan of the mule, of which the following are the particulars: Fig. 5.

The length from A to D, and from B to C, ought to be 10 or 12 inches more than that of a mule with a single row of spindles, supposing the length of draught to be the same, because the row of spindles, nearest to the guide H, can never be brought so nigh to the rollers by nearly a foot as in a common mule. The breadth for an equal number of spindles is taken at one-third of an ordinary mule, supposing 12 inches to be allowed for each dozen of spindles, which is very common, excepting for mules intended for coarse yarn, in which case 14 or 15 inches are generally allowed. From the smallness of the scale upon which the plan is laid down, every *third* spindle only is represented; so that each diagonal row of the spindle frame E ought to contain 12 spindles, or 13, if both extreme spindles are counted into one row. These spindles will be one inch asunder, and the whole mule, although only six feet wide between the frames, will contain 216 spindles, which, in the common mule, is estimated to be a large number, and requires 18 feet within the framing, at one inch asunder. The framing is bounded by ABCD; the diagonal spindle frame is at E; the rollers, which (if 12 inches between the couplings, will draw for three dozen of spindles each,) are at F; the frame which contains the *roves* or *rovings*, from which the yarn is to be spun, is at G. The guide

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for directing the yarn in winding up and building, or forming the *cop*, is at H. The three pullies, for the single speed, the double speed, and disengaging the mule, are at I; the large wheel for driving the cylinder or drums, as the case may be, which turn the spindles, is at K. The smooth roads of iron, or, as they are usually termed, the *race roads*, upon which the carriage moves, are at LL; and the shaft, which moves the rollers until the delivery ceases, is at M.

Plate CCXII. Fig. 6.

Fig. 6. is a perspective view of the mule, as it would appear at the distance of 10 or 12 feet from the left hand front corner. The guide H, and the connecting shaft M, are omitted, because they would conceal other parts if introduced, and also because they are sufficiently laid down in Fig. 6; there being nothing materially different in their construction from the common mule, excepting that the arms of the guide are longer, in order that the directing wire may descend, without interruption, over all the diagonal rows of spindles. All the other letters of reference denote the same part in Fig. 6. that they do in Fig. 5. The upper, or leathered rollers, are also omitted, there being nothing peculiar about them.

We come now to the most essential and interesting part of this subject, namely, the comparison of this machine with those at present in use, and the immense saving of sunk capital of which it may be rendered productive. For the sake of perspicuity, we shall arrange this estimate under the three distinct heads, pointed out in the introductory part of this section.

1*st*, *The Expence of Building.*

Expence of building.

We have seen that, by placing the spindles only one inch asunder, a mule of 216 spindles will require a space of 18 feet, exclusive of what is occupied by the framing, and the space allotted for the driving pullies, and large twining or twisting wheel. If four feet be allowed for these, and only five feet more for passages round the machine, the breadth of the building (within the walls) must be 27 feet at least.

The breadth of this machine (containing an equal number of spindles) will be only six feet within the framing, to which, if we add the same allowance for framing and passages, we shall have 15 feet; and as only one passage is required in the middle, we have two sets of mules, with a middle passage of three feet, exactly in the same bounds as were required in the former case. Here, then, we have the number of spindles doubled in the same bounds; or, in other words, the saving upon the building amounts to 50 per cent. or one-half of the whole.

2*dly*, *The Expence of Power and Mill Work.*

Expence of power and mill work.

The saving of power will be found to be in a still greater ratio.

In the *first* place, we have only one-third part of the drawing rollers to move, and have, of course, only one-third of the weight, and one-third of the friction to overcome. We have, indeed, the same number of spindles; but as the house will contain two rows, and will be only one half of the length, the whole is brought more contiguous to the power, and one half of the weight, friction, and expence of the mill shafts will be saved; besides which, the engine will only require at most half the power, and consequently may be erected at less than half the expence, and wrought with less than half the fuel.

3*dly*, *Expence of Machinery.*

Expence of machinery.

The expence of the machinery may very fairly be estimated in the same way. Two-thirds in length of the cross-railing, carriage, rollers, &c. will be entirely saved; and from the short and compact shape of the mule, every part may be reduced in materials two-thirds, with greater strength than before; for the stress being as the length multiplied into the weight, and two-thirds of each being saved, the product will be in the ratio of 1 to 9, or nearly so, when compared with the former. For if the length be expressed by a, and the weight by b, the stress will be as $a\,b$; and if two-thirds are taken from each, the result will be $\frac{a}{3} \times \frac{b}{3}$ or $\frac{ab}{9}$. The weight and expence of the whole shafts may be reduced in a similar ratio, without any diminution of strength.

After having maturely weighed this plan during some years, and submitted it to the inspection of several extensive practical spinners, no objection whatever to its practicability has ever been stated; although it would have been very natural to expect that those, who have already embarked their property in establishments on the present plan, from which it could not be withdrawn, *under any contingency*, without an immense and ruinous loss, would be far from desirous to promote, or even sanction a plan, the very object of which is to enable others to compete with them at less than half the expence.

One objection, however, does exist, which, although it does not appear impossible, nor even very difficult to surmount, it ought to be candidly and explicitly stated, in order to guard the engineer, who may attempt to reduce this plan to practice at an early period, against what will prove his chief obstacle.

The diagonal form in which the spindles are placed, necessarily brings the threads much nearer to each other than by the common plan; and as some threads break at almost every draught, there is reason to apprehend, that the contiguity of the threads may, in this case, prove of some practical disadvantage. A fractured thread, especially after having received a considerable degree of twisting, has always a tendency to deviate from the straight line in which it was stretched, and to entangle itself with the adjacent threads. The nigher that the threads are brought to each other, this disadvantage must be the more increased, and consequently there certainly exists a danger, that, in this plan, one thread may frequently be the cause of breaking many, unless some means be resorted to, to keep them asunder. The tendency of a thread to deviate from the line in which it was stretched, it is presumable, must be in the ratio of the square of its length; for its utmost possible deviation would be 90° from its former position before the fracture. Hence we find that in spinning, if a thread gives way at an early period of the draught, when the spindles have receded but little from the rollers, it seldom if ever does the smallest injury to the contiguous threads; and we also find practically, that the greatest mischief is produced in twisting the threads at the end of a draught, when the yarn is at its greatest stretch, and when both the delivering rollers and the carriage have ceased to move. On this principle, the following

Cotton Spinning.

small addition, which is neither complex nor expensive, is suggested, as a mean of greatly reducing, if not entirely removing, this inconveniency.

Plate CCXII. Fig. 5.

Across the machine, under the threads, and sufficiently low not to interrupt the action of the guide, let there be one, two, or, if necessary, more shafts of wood, like that represented at N. At each end of this shaft, let there be a cross piece of iron, or strong wire, as at PP, and let these pass through sockets or eyes in the frame, so that N may slide freely to and from the rollers as required. Then, if a number of smooth wires or pins be driven or screwed into N diagonally, like the dots in the Figure, they will keep the yarn asunder, and prevent the inconvenience alluded to; N will follow the spindles, when drawing out, as far as is found convenient, where it may be stopped with a pin, by a small weight suspended over the pullies O, O, and the carriage returning will push N before it, so that no interruption can take place. Thus the threads may be kept asunder at as many points as are found convenient, with very little trouble or expence.

If it be found desirable that the threads should be farther asunder, without increasing the breadth of the machine, this also may be effected in another way. If the diagonal spindle frame E, instead of being horizontal, be sloped to any declivity like an inclined plane towards the rollers; the points of the spindles will also form an inclined plane parallel to the former, and, in proportion to the degree of obliquity, the threads will be farther insulated from each other. In this case, the face, or directing part of the guide, instead of being a straight wire, must be formed into inclined planes, corresponding to the slope of the points of the spindles.

The above can hardly be considered as a fully matured and digested plan, nor perhaps is it possible for the most comprehensive mind to enter minutely into every detail, investigate every minute property, and counteract every latent defect of complicated machinery, without the benefit of actual experience. If the outline of a plan, practicable and simple in itself, has been traced out; and if it has been proved, that this plan, if properly matured, and more early adopted, might have been the means of saving many hundred thousand pounds sunk in spinning machinery, much has been effected.

All machinery, kept in constant use, and subjected to constant friction, soon wears out; and must be replaced either by similar engines, or improved substitutes. The plan being submitted to public inspection, its advantages may be appreciated and adopted, and its defects removed, by attention and experience, like those of all infant machinery.

Mule-yarn.

Mule-yarn is used for a great variety of purposes. It has almost entirely superseded that spun on jennies, and water twist is now used only for hosiery and for purposes requiring great strength.

As mules require little power to work them, they are chiefly used where steam engines are employed, as in Manchester, Glasgow, and other manufacturing towns.

Water-twist.

Water twist, on the other hand, is spun principally in country situations, where power is cheaper, being produced by water.

Improvements in the machinery.

The rapid improvement which has taken place in the machinery of cotton spinning is unparalleled in any other manufacture. This rapid improvement is, perhaps, chiefly to be attributed to the liberality of those engaged in the cotton trade, in sparing no expense for making the necessary experiments. The great profits of the business for a long period put it easily in the power of those who, in any tolerable degree, understood it, to make such experiments with advantage.

Buildings.

The reader will even already perceive, that many of the contrivances in use are wonderful for their ingenuity, nor is the general *system* observed in conducting the operations of a well-regulated cotton mill, less wonderful. The buildings, for water spinning, usually consist of five or six stories. In the two first is generally placed the spinning frames, and over these, in the third, the *preparation* machinery, and in the fourth the reeling; but the arrangement of the buildings is various according to circumstances. The buildings for mules, commonly have the *preparation* machinery below. Each machine may be stopped separately from the rest, and even particular parts of the same machine.* Many of the mills are now built fire-proof, and steam is much employed for heating them. Gas light is used in several, and is likely to be still farther extended. †

Besides having the buildings fire-proof, the general use of cast iron in the framing, as well as in other parts of the machinery, contributes greatly to diminish the risk from accidental fire, at the same time that it costs less, while it is neater and more commodious. Indeed, without the use of this material instead of wood, it would have been impracticable to construct, in the time, the machinery now in the island. The pattern being once made, it is obvious that any number of the same parts may, in a very short time, be cast from it; whereas, when the parts are made of wood, the labour is continually repeated in the formation of every new part, although exactly the same as those already constructed.

From this general sketch of the machinery employed in the spinning of cotton, it is presumed the reader, previously unacquainted with the subject, will be prepared more easily to comprehend the subsequent explanation of machinery illustrated by Plates. Premising, however, that the jenny being now in a manner obsolete, we deem it unnecessary to give any Plates on that subject, and that we have elsewhere (see p. 279, &c.) described the process of *batting* or cleaning, and opening the raw material.

DESCRIPTION OF THE PLATES.

Description of the Plates.

Having elsewhere (see p. 279, &c.) described the process of *batting*, which, by opening the hard and compressed masses and disengaging the seeds or *gins*, prepares the cotton for carding; we come now to explain the operation of carding, by the help of Figures. This, as before observed, is the second elementary process. The mode which we mean to adopt in describing this and the following operations, is not to give representations of the whole machines, but rather what may be called diagrams of little more than the parts of the mechanism which

* For a more particular description of such contrivances than our limits will permit, see Buchanan's *Essay on Methods for Disengaging and Re-engaging Machinery.*

† See Buchanan's *Essay on Fuel,* &c. where the details of heating mills by steam are given, and also some account of the gas lights.

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come into *contact* with, or *produce an immediate effect* on, the cotton in various parts of the process of spinning. This mode we conceive to be the most simple of giving the reader an intelligible description; for were the machinery for communicating the motions represented together with the framing, it would render the subject far more complex and obscure; and it is further to be observed, that the communicating machinery and the framing are very different in different mills, and are almost daily changing in new erections, while the parts coming in contact with the material under process remain nearly, if not entirely, the same. The mode we have adopted, we think, will not only give a better general idea of the subject, but will make the reader more readily comprehend the construction of the machines themselves when he has an opportunity of seeing them, than a more laboured and extended description, which representations of the whole machines would require, and of which our limits would not admit.

The operation to be performed by the carding machines (the first denominated the *breaker* and the second the *finisher,*) will probably be more easily understood, after we have considered the effect produced by the common *hand-cards,* which every one must have seen.

Carding machines.

The cards are composed of small wires stuck through a sheet of leather, forming a kind of brush. The wires are not perpendicular to the plane of the leather, but are all inclined in one direction at a certain angle. The hand cards consist of two boards with handles, each board having a sheet of cards nailed on it.

Plate CCXIII. Fig. 1.

AB and CD, Fig. 1, represent, in profile, part of the boards of a pair of hand cards; EF and GH the leather; and IK and LM the teeth.

Fig. 2.

Fig. 2. shows the form of one of the wires which are stuck through the leather; each wire forms two teeth.

If cotton be stuck into one of those cards, and the other drawn against it, the effect of repeated strokes of the empty card in this direction against the full one, will be a more equal distribution of the cotton upon the card teeth, which will have the effect of separating the fibres, disentangling every little knotty part, and laying the whole more straight. Now, if one card be drawn in an opposite direction over the other, it will, in consequence of the inclination of its wires, take the whole cotton out of the card whose inclination is contrary.

Fig. 3.

In order to explain the imitation of this process, as performed by the carding machines, we refer to Fig. 3. (being a vertical section of the *breaker,*) in which AB represents a cylinder (usually about three feet diameter and two feet long,) on which sheets of card are nailed parallel to the axis. The teeth all pointing, as shown in the Figure, in the direction of its motion, which direction is pointed out by an arrow. This cylinder is turned rapidly round, usually at the rate of from 60 to 80 revolutions per minute, by an endless leathern strap or belt on a pulley fixed on its axis. This cylinder being the first motion of the machine, all the rest are communicated from it.

The cylinder AB, is called the *main cylinder,* and revolves under an arch CD, consisting of several pieces of wood, each covered with a sheet card also parallel to the axis of the cylinder, with their teeth directed to oppose those of the cylinder, and coming nearly into contact with them, that is, within about one-twelfth of an inch of touching. These pieces, of which the arch consists, are called the *top-cards.*

Cotton Spinning. Carding machines. Plate CCXIII. Fig. 3.

The second cylinder EF is covered with card, the teeth meeting those of the main cylinder. This card is what is called a fillet, being a narrow ribband wound round the cylinder in a spiral form, so as to make the surface of the whole one uninterrupted sheet of card teeth. This cylinder moves in the direction shown on it by the arrow, but much slower than the main cylinder.

A certain weight of cotton is spread upon a certain length of the feeding-cloth GHI, which gradually advances. The cotton is taken from it by a pair of fluted iron-rollers KL, which deliver it equally to the main cylinder. This cylinder carries it round, and works it against the cards fixed within the arch. By this means it becomes equally distributed over the main cylinder. The cotton advances slowly from tooth to tooth, sometimes on those of the arch or top cards CD, and sometimes on those of the cylinder, until it has passed through the arch. It then comes to the second cylinder EF. Now, the property of two cards meeting each other being to distribute the cotton between them, the teeth of the second cylinder receives a full half of what is upon the teeth of the main cylinder. The cotton received by the cylinder EF, proceeds with it beneath till it comes to the opposite side, and is removed by the *taker-off.*

This curious piece of mechanism, the *taker-off,* consists of a comb of polished iron Q, which receives a reciprocating motion by means of sliding-rods MN working in guides above the comb from a crank at N. The comb moves so as to descend at the time when its edge is nearest the cylinder, and thereby combs or scrapes the teeth downward, and in consequence removes the cotton from the whole length of the cylinder EF. The motion of the crank is so quick, that the cotton is stripped off the cylinder in a continued and connected fleece. The disposal of this fleece forms the principal difference between the *breaker* and the *finisher.* In the *breaker* (which we are now describing,) it is received on a smooth cylinder OP, called the *lapping cylinder,* moving regularly at the rate the fleece is delivered, having a small roller R resting lightly above it, which causes the fleece to lap regularly on the cylinder, which continues to revolve until it has made about 20 revolutions, when, by means of an apparatus for the purpose, the machine stops, and the cotton is broken off by hand, forming a fleece, consisting of about 20 thicknesses, called a *lap,* which is ready to be carried to the *finisher.* This is the first operation in which the elementary process of *plying* or *doubling* occurs. The advantage of this process in this last part of the operation, is producing great equality in the thickness of the *lap,* which being fed on to the *finisher,* produces from it a regular sliver, upon which circumstance the perfection of the ultimate thread must depend.

Fig. 4. No. 1. and No. 2. represent a front view and plan of the *taker-off* of the *finisher,* on a larger scale; the same letters expressing the same parts as in Fig. 3. and 6. The taker-off is constructed in the same manner, both in the *finisher* and in the *breaker.* Fig. 4. No. 1, 2.

A vertical section of the *finisher* is represented in Fig. 5. The *lap* produced by the *breaker* is, in some mills, laid on a feeding cloth; in others it is placed in a tin canister; but in both cases it is fed into the main-cylinder by the feeding rollers, in the same way as in the *breaker.* The other operations of the cotton are the same in both machines until it passes the taker-off. Fig. 5.

Cotton Spinning.

Carding machines.

PLATE CCXIII. Figs. 4. 5.

The fleece from the *finisher,* instead of going to the lapping-cylinder, is gathered into a tin funnel marked *a,* (see also Figs. 4. and 5), and then passes between a pair of rollers *b, c,* which compress and flatten the fleece in its contracted state into a pretty firm and connected sliver or band, called a *card-end,* and deliver it into a can *d,* which, when full, is ready to be carried to the next operation performed by the drawing-frame.

The carding machines we have described, are those on the construction at present most approved; but many other constructions are employed. Instead of dead *top cards* are rollers, sometimes called *urchins;* but they are certainly more complex, and produce no superior effect. In some cases, the operations of *breaking* and *finishing* are performed on one large machine, having two *main cylinders* and two *doffing cylinders,* surrounded by a number of *urchins.*

This plan of double engines saves a great deal of attendance in conveying the *lap* of the *breaking card* to the feeding cloth of the *finisher,* but it is less perfect, as it has not the advantage of *plying* or *doubling* the fleece previously to the *finishing.* It is, however, sufficiently perfect for very coarse goods, and was the prevailing mode used in the preparation of cotton for common jennies.

Every part of the carding engines, where dust or films of cotton can escape, are now generally carefully enclosed, to prevent the pernicious effects on the lungs of the people employed in attending the engines.

We already mentioned, that in a cotton mill every machine, (and even particular parts of some machines), may be stopped or set agoing separately from the rest of the small machinery. There are a great variety of contrivances* for this purpose; and it may be proper to describe in this place one of them, remarkable for its simplicity and beauty, which is now commonly applied to carding engines. It is called the *fast and loose pullies,* or *dead and live pullies.*

The Fast and Loose Pullies.

Fast and loose pullies. Fig. 6.

The pulley B is fixed on the axle A of the main cylinder of the carding engine, and the pulley C, having a bush, is loose. The belt or band which conveys the motion from the mill-work, may at pleasure, either by hand or by a lever, be shifted from the one pulley to the other. When running on the loose pulley C, the axle stands still; when on the fast pulley B, the axle moves.

This contrivance of the fast and loose pullies is attended with no shock while throwing into action, and is perhaps the most perfect thing yet invented for the purpose in all cases where it can be applied.

Drawing.

Drawing.

The fourth elementary process, that of drawing, on which the great merit of Arkwright's system depends, is performed in the *roving frame* and *spinning frame,* as well as in the *drawing frame.* We may therefore first explain this elementary process. Its application in each of these different machines, when we come to speak of them, will then be more easily understood.

The object of the process of drawing is to imitate the human finger and thumb in drawing out the fibres; and although the first idea of the mechanism was taken from the elongation of a red hot bar of iron, by means of a pair of rollers, yet it is obvious, that although a sliver of cotton may be compressed by a single pair of rollers, it cannot be elongated; but, as shall immediately be explained, that effect may be produced by *two* pair of rollers.

PLATE CCXIII. Fig. 7.

In Fig. 7. A represents an iron roller fluted longitudinally with sharp flutes. B is another roller, covered with leather, and pressed downward upon A by a weight. If a sliver of cotton be put between them, while moving in the direction expressed by the arrows, it will be *compressed* but not *extended.* If the sliver be made to pass through a second similar pair of rollers, if they move in the same direction, and at the very same velocity, no extension of the sliver, even in that case, can take place; but suppose C and D to move at double the velocity of A and B, then the sliver will be extended to double its former length; for C and D will take up the cotton faster than A and B deliver it. It must either be forcibly pulled through the first pair of rollers, or it must be extended a little by the fibres slipping among each other, or it must break. When the extension, however, is moderate, the effect is merely to draw the fibres into a more favourable situation for extension. The relative motion of the rollers, as formerly mentioned, is called their *draught.*

The Drawing Frame.

Drawing frame.

Besides merely *drawing,* the machine we are now to describe, (the drawing frame), doubles or plys the cotton; and these elementary processes combined, produce, besides the effect of equalizing the sliver, that of laying the fibres of the cotton nearly parallel to each other.

PLATE CCXIII. Fig. 8. PLATE CCXIV. Fig. 1.

Fig. 8. of Plate CCXIII. and Fig. 1. of Plate CCXIV. represent what is termed one *head* of a drawing frame. A *frame* usually consists of several *heads,* which are in fact each a distinct machine, but so arranged on a frame, as to form one system. If one head, therefore, be understood, the whole system is easily comprehended.

A represents a group of four tin cans brought from the carding machines. The four *card-ends* from these cans are passed through the rollers B, C and D, E, (which have, suppose, a *draught* of four.) The slivers are then united and conducted by a pair of rollers F, G, (which do not extend the cotton,) into another can H, which sliver being extended to four times the length of the *card-ends,* is therefore the same size as one of them, but is more uniform, and the fibres are laid more straight.

This operation being repeated, through several other *heads* on the same frame, the fibres of the cotton are laid nearly parallel, and the sliver becomes still more uniform, and is then ready to be carried to the roving frame. The number of these operations, and the *draught* of each *head,* and also the number of plies, are optional, and are varied according to the nature of the cotton, or other circumstances. For the sake of simplicity, we have described each *head* as having only two pair of rollers, although three or more pair are now often used in each head. In this last way the cotton is more gradually and equably extended than when the whole draught is produced at once.

Roving.

Roving.

The fibres of the cotton having been laid parallel by the drawing frame, it is necessary to reduce the sliver to

* See Buchanan's *Essay on Methods of Disengaging and Re-engaging Machinery while in Motion.*

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a convenient size, preparatory to reducing it still further by the spinning into a small thread; and to accomplish this purpose, it becomes necessary to give the sliver a degree of twine while drawing, in order that it may have adhesion sufficient to undergo the stress of spinning.

The making of good rovings is a most essential part of cotton spinning. They ought to be uniform in size, have an equal degree of twist in every part, and that twist should be no more than what is just sufficient to give the requisite degree of strength.

A great variety of constructions of machines for roving have been in use at different periods. We shall begin with that which was used by Sir Richard Arkwright.

The Can Roving Frame.

The *can* roving frame. Plate CCXIV. Fig. 2.

One head of the roving frame is represented in Fig. 2. Each *frame* contains several similar *heads*; but by tracing the progress of one roving, that of the rest will be easily comprehended. A, A represent two tin cans, each containing a sliver from the drawing frame. The slivers enter together between the rollers *a b c d.*

The rollers of this machine are similar to those of the drawing frame. The sliver, after being reduced by passing through the rollers, is received into a can or box B (in the form of a truncated cone) through a small funnel *e* at its upper end. This box is supported at bottom by a pivot *f*, and kept in rapid motion by a band. To keep the box steady as it revolves, the neck of the funnel *e* is guided by a collar. The boxes have each a door to open on one side for taking out the cotton rovings. This door is secured by a ring *g*, which fits the outside of the box, and when pushed down, keeps the door shut; but when drawn up to the top, the door may be opened and the rovings taken out.

The sliver, after being reduced by the rollers passing through the funnel *e* into the box, is twisted, and by the centrifugal motion coiled round within. The attendant knows, by experience, the time when the box is full, and lifting up the ring, withdraws the rovings. They are then ready to be carried to what is called the *winding block.* This is a very simple machine (moved by hand) by means of which the roving is wound on bobbins.

This mode of roving was found defective in two respects: 1st, The twine was not equally diffused over every part. 2d, The winding the cotton by a separate process damaged the tender rovings.

To remedy the first of these evils, Arkwright tried rollers on the top of the revolving can or box, which were contrived to move at the same rate as the drawing rollers delivered the roving; but in practice this mechanism was found to be attended with considerable objections, and for that reason has been abandoned for other and more perfect machinery.

The following method is now much in use: Instead of taking the rovings out of the box and winding them on bobbins, a can is put within a revolving frame, (called a skeleton,) having a top and bottom, similar to those of the revolving box. The rovings, when the cans are full, are carried, without being wound on bobbins, to be further reduced and twined on a machine called a *stretching frame.* By this method the damage which the roving otherwise sustains in winding by hand is avoided.

The Jack Frame.

Jack frame.

To obviate both the evils mentioned above, many contrivances were tried. A machine called a *jack in the box* was long in use in some mills. It was very ingenious in its construction; but its great fault was its complexity. It consisted of a frame revolving rapidly instead of the revolving box or can of the *can frame.* Within this revolving frame a small cylinder moved vertically, the surface of which had the very same velocity as the surface of the front roller of the roving frame. Upon this cylinder the bobbin was placed, which, by contact, revolved and took up the roving at the same rate at which it was delivered by the rollers. At the same time the horizontal rotatory motion of the jack gave the twist to the roving, a guide-wire also built the roving regularly on the bobbin.

Plate CCXIV. Fig. 3.

The sketch in Fig. 3. will give an idea of this machine, and of the simple contrivance for making the *surface* of the bobbin, whether empty or full, always move at the same velocity.

A is the cylinder, revolving at such a rate that its surface has the same velocity as that of the front roller. B the bobbin lying on it. C the guide-wire.

But this machine, (the jack in the box,) has been superseded by another, which is more simple, while it is calculated to produce the same effects, viz. diffusing the twine equally in every part, and saving the winding of the rovings by hand. This is effected by means of the spindle and flyer, similar to those of the common flax-wheel; and although Arkwright tried to apply this part of machinery to roving, he did not succeed. He found difficulties which were, even to him, insuperable, but which time and experience have at length overcome.

Spindle and Flyer Roving Frame.

Spindle and flyer roving frame. Fig. 4.

This machine has its rollers, &c. for drawing or reducing the sliver, the same as the roving frames already described. Instead of the revolving boxes, there are spindles AA, Fig. 4. each of which has fixed at its upper end a forked piece of iron called a *flyer.* One of the legs *b* of the fork is made tubular, to receive the roving as fast as it is twisted by the motion of the flyer, and to convey it to the bobbin, which is fitted loosely on the spindle.

The rollers deliver the reduced sliver to the flyers on the top of the spindles, where it passes through an eye-hole *a* of the flyer, exactly above the centre of the spindle, and thence proceeds through the tube *b* to the bobbin *c.* The tube of the flyer running swiftly round the bobbin, lays the roving on it as fast as the rollers deliver the cotton. In the common flyer of a flax wheel, there are teeth from one to another of which the thread is shifted from time to time by hand, in order to fill the bobbin regularly; but to answer this end, and in a more perfect manner, this machine is so constructed, that the bobbins rise and fall on the spindles, that they may lay the roving from the end of the tube regularly upon the length of the bobbin. This rise and fall of the bobbins is accomplished by the motion of the wooden rail BB, which, by a piece of mechanism, is kept in regular, slow, alternate ascending and descending motion.

The application of the spindle and flyer to roving, as far as we have yet described it, is the same as was tried by Sir Richard Arkwright, upon finding the defects of his roving can frame. But the objections to the machine in this state, and which he found unsuperable, were, that the bobbins when they became filled with rovings, being much heavier than when empty, required much more force to drag them round. The bobbin rested on the rail, and was retarded from moving as fast as the spindle by friction only. Had it moved as fast as the spindle, it is obvious it could not take up the roving. Again, had it been stationary, the flyer would have had the effect of stretching and breaking the roving. The bobbin therefore required a slow motion, and that motion to increase gradually as the bobbin became full; for the quantity of roving taken up by the bobbin depends on the difference between the motion of the flyer, and bobbin which follows it. But not having any proper means of producing this varying motion, the weight of the bobbin increasing, increased the friction, and thereby stretched the roving, and consequently rendered the machine inadequate to its proposed end.

This objection is now obviated in the improved spindle and flyer roving frame, by means of mechanism, which communicates such motion to the bobbin, that it will take up the roving just as fast and no faster than the front roller delivers it. To effect this, it is necessary that the velocity of the bobbin be altered every time the bobbin has a new layer of roving beginning to be lapped on it, for the bobbin increases in diameter, and the velocity of its acting circumference must at all times remain the same.

The mechanism, by means of which this change in the velocity of the bobbin is accomplished, is different in different mills, or in different machines. We may shortly describe the two methods most approved.

In some machines it is produced by means of two conical barrels of the same dimensions, but placed with the larger end of the one opposite the smaller end of the other. The one of these barrels moving uniformly, communicates motion to the other by an endless strap, which, by being shifted toward either extremity, varies the motion of the other barrel. The belt, or strap, remains equally tight in every part of the barrels, for the one barrel increases in diameter exactly as much as the other decreases. From the second barrel, motion is conveyed to pullies resting on the bearer or rail BB, and having the spindles passing through the centre of each. The bobbins rest on those pullies, and are carried round along with them.

In other machines, instead of the conical barrels, two wheels, having no teeth, but covered with leather, the one bearing on the face of the other, moves it by contact, and varies the motion, by approaching and receding from the centre of the face wheel. For a more particular account of these two pieces of mechanism, and other similar contrivances, see Buchanan's *Essay on changing the velocity of Machinery while in Motion.*

Although this species of roving frame requires very accurate adjustment, yet, from its merits in other respects, it promises to be generally adopted in this important department of cotton spinning.

The rovings prepared either by this machine, or otherwise, are carried to the next operation, which in water spinning is performed on what is termed the water spinning frame.

Water Spinning Frame.

Water spinning frame.

We come now to describe the *water spinning frame*, the machine for which Sir Richard Arkwright obtained his first patent. A general idea of it may be formed from the preceding description of the application of the spindle and flyer to roving; but as the thread in spinning has sufficient strength to bear the drag of the bobbin, no mechanism for regulating it is required, but the bobbin rests on the bearer, and is retarded by friction from moving as fast as the spindle.

Plate CCXIV. Fig. 5.

Fig. 5. is a profile of one head of the spinning frame. Some use heads of four spindles, and others of six spindles. A is the binder, or pulley, loose on the axle CD. The binder is kept in motion by a broad belt from a drum on an upright *shaft* of the mill work. E is the *list pulley* fixed on the axle CD. In order to disengage, or re-engage the axle CD from the list pulley E, and thereby to stop, or set agoing, the head of spinning connected with it, a contrivance called the locking bayonet is used. It consists of a kind of fork *a b c d*, which passes through two holes in the *list pulley* E. The bayonet is moveable upward and downward on the axle CD, which passes through its collar *b c*. Around this collar there is a groove, into which part of what is called the *lifter* projects, and by means of which the bayonet is, by hand, at pleasure raised or depressed. While the bayonet is in the situation represented in the Figure, the binder A keeps running on its bush, and the axle CD is at rest.

In order to set the axle in motion, the bayonet is depressed, and its legs *a* and *d* lay hold of two projecting teeth, or pieces of iron, in a groove in the upper end of the binder A. The list pulley E is thus locked or connected with the binder, and it and the axle are carried round together, and thereby motion is given to the whole of the moving parts of the *head*.

This contrivance of the *locking bayonet* is used for disengaging the drums on the upright shafts of the millwork. It was also used in Arkwright's can, roving frames, and various other parts of cotton machinery; but the contrivance denominated the *fast and loose pullies*, or, as they are sometimes called, the *dead and live pullies*, already described, has now in many instances superseded the bayonet, to which it is to be preferred in all situations where circumstances will allow, as by it the belt carries the pulley into motion without any shock. But a great improvement on the locking bayonet has of late years been introduced. Instead of making it, when thrown into gear, strike against permanently fixed teeth, or a fixed clutch, it strikes against the ears of an iron hoop, which embrace a fixed pulley. In consequence of this construction, the machine is not suddenly jerked into motion when the bayonet is let down, but the clisp slips round a little until its great friction gradually brings the machine into motion. See Buchanan's *Essays.*

The elementary process of drawing, (or further reducing the roving into a size proper for a fine thread) is performed in the *spinning frame* by fluted rollers, &c. similar to those of the roving frame, but instead of two, three sets of rollers are used, to which motion is given in the following manner: On the top of the axle CD is a pinion F, which works into a face wheel, represented by a dotted circle, (in order that the rollers may be better seen, of which a vertical section is shewn in the Figure,) fixed on the end of the front roller *e*, from which, by a train of wheel-work, motion is communicated to the middle roller *f*, and the back roller *g*. This train of wheel-work is calculated to give the requisite degree of *draught*, (usually about seven or eight.) Between the mid and back rollers there should be little more *draught* than what is just necessary to begin to pull the rove from the back rollers; for it is found that the thread is more even when the fibres are pulled by the front rollers from between the middle rollers. The back

Fig. 5.

Cotton Spinning.

PLATE CCXIV. Fig. 5.

rollers serve to keep the roving from being pulled too fast forward; the top roller *h* in the middle is much lighter than the other top rollers, and permits the fibres to move freely among themselves in reducing the roving.

GH represents the spindle, to which motion is communicated from the list pulley E, by means of a strap formed of cloth listing IK, which goes round the *spindle shaft* at I. *i k l* is the flyer, the legs of which consist of two solid pieces of iron, twisted somewhat like a corkscrew at the lower extremities *i* and *e*, in order to conduct the thread to the bobbin *m n*.

The operation of this machine will now be easily explained. The bobbin containing roving L is placed in a frame behind. From it the roving passes to the back rollers *g, p*, through a wire eye *o*, fixed in a wooden rod *r*, that has a slow reciprocating horizontal motion. The use of this motion is to make the roving traverse a little on the rollers, to prevent it from wearing them, or bruising the leather too much in one part. The roving being reduced in its passage between the three sets of rollers, proceeds through the *leader q*, (which is an eye formed of wire fixed in the *leader board*) to the flyer, which twists and lays the thread on the bobbin *m n*, in a similar manner to what we have already described of the flyer used in the roving frame.

The ascending and descending motion of the bobbin for building the thread regularly, is produced as follows: A wheel in the form of a heart, called the *heart wheel*, moves with a regular vertical motion, and acts on a roller, which, by means of levers, alternately raises and depresses the bobbin rail M. This rail has pieces of thin wood *x y* projecting from it, which go under the bobbins, and on which pieces they rest and are moved along with the rail. The motion is so calculated, that when the bobbin is full of yarn it is swelled a little somewhat into a barrel form. The bobbin (as was observed of the spindle and flyer roving) does not revolve with the velocity of the spindle. In the spinning frame it is *retarded by friction*, which is increased to the requisite degree by means of washers of cloth or leather; then the thread, by the motion of the flyer, drags the bobbin about after it, with a velocity equal to the difference between the motion of the flyer and the motion of the thread delivered out by the front rollers. The thread is sufficiently strong to bear, without injury, this drag of the bobbin, and therefore, as before observed, it does not require the mechanism to regulate its motion, which is necessary for the delicate rovings.

When the bobbins are full, the attendants take them off the spindles. The dexterity with which this work is performed, as well as that of the mending of the threads, (for which last purpose it is not always necessary to stop the spindles,) is almost incredible to those who have not witnessed these operations.

The bobbins, when taken off the spindles, filled with water-twist for warps, are carried to be reeled. But stocking yarn undergoes the operations of doubling and twisting. This last kind of yarn is softer than common water twist, and requires to be more even, because, in a stocking, the whole of the texture at any one part is formed by the same thread, and any defect will make a bar in the stocking, whereas, in cloth, so many different threads cross each other at one place, that a defect in any one thread is seldom perceptible in the cloth. In order to obtain greater evenness, stocking yarn is usually spun from double rovings, wound on the same roving bobbin. The roving can frame is therefore still used in the preparation for this kind of spinning.

Cotton Spinning.

The Throstle.

Throstle.

Water twist is spun on a spinning frame of another form, called the throstle. The operating parts are the same in both machines, but the mechanism which actuates them is different. A very short description, however, after what we have said of the spinning frame, will suffice.

The rollers and spindles are similar to those of the water frame, but instead of *heads*, each of which may be stopped independently of the rest, the whole rollers of one side of the frame are coupled together, and the whole of the spindles of both sides of the throstle are driven, by means of bands or lists, from a cylinder A, Fig. 6. which extends the whole length of the machine. This cylinder receives its motion by a belt, and from its axle motion is communicated by wheel work to the rollers. Thus, by stopping the cylinder, which has dead and live pullies at the end of its axle, where it receives its motion, we stop the whole machine.

PLATE CCXIV. Fig. 6.

This machine is more simple, consists of fewer parts, and of course costs less than the water spinning frame. It is generally stated to require less power to work it. But it has an evident disadvantage, viz. that in taking off the full bobbins, the whole spindles of the throstle must be stopped; whereas only a single head (of four or six spindles) of the water frame requires to be stopped during this operation. On the whole, cotton spinners are still divided in their opinions as to the comparative advantages of these two machines.

The Reel.

The reel. Fig. 7.

In some mills the reels are moved by hand, in others by power. A, Fig. 7. is a board going the whole length of the reel. In this board a number of wooden pins are fixed, of such a size that the bobbins may turn freely on them. B represents one of the bobbins. The thread from the bobbin is conducted between several wires, and has a turn round one of them, in order that it may be conducted with sufficient tension to the reel CDE. It consists of six rails *a a a*, &c. which extend parallel to the axis the whole length of the reel, and on which the thread is wound. The dimensions of the reel are such, that it requires exactly one yard and a half to go round it. The length depends upon the number of bobbins which it winds at once—sometimes as many as 50. The reeler begins with making the ends of all the threads fast to one of the rails *a*. By means of wheelwork, when the reel has made 80 revolutions, (one lay) a bell or click strikes, the reel is stopped, and the lays are tied with pieces of thread, in order to keep them distinct. Seven of these lays form a *hank*. When the hanks are completed, they are taken off the reel. The arms of one of the rails is hinged, which permits it to be folded inward, in order to take off the yarn with ease, by slipping the hanks to one end of the reel, which is lifted off its bearings for the purpose.

The hanks are then twisted into knots, and weighed on the quadrant, or averaged on a scale, in order to ascertain the size of yarn. It is afterwards made up in cubical bundles for the market.

Having thus concluded our proposed description of the machinery of *water spinning*, we shall now proceed to finish what we intended to say on the subject of *mule spinning*.

Cotton Spinning.

Mule spinning.

Mule Spinning.

The preparation machinery in this species of spinning, as has already been observed, is the same as that of water spinning. Mule yarn differs in this respect from water twist, that in the operation of spinning the former, an additional *elementary process* is introduced, namely, that of *stretching,* which takes place after it has been *drawn* by the rollers. The effect of this *stretching* is twofold; it makes the yarn finer than it would be by *drawing* alone, and it causes the yarn to be more even: for those parts of the thread which are of the greatest diameter, as delivered by the rollers, receive less of the twine from the spindles than the smaller places, and consequently the larger yield more easily in stretching; meanwhile, the twine becomes more equally diffused over the whole thread. But the great advantage which the *mule* has over the *water-frame,* is in producing much finer yarn than is possible by the latter machine. The principal reason seems to be, that, in the water-frame, the yarn must have sufficient strength to drag the bobbins; whereas, in the *mule* no bobbins are used, and the yarn is built on the spindles in such a manner as to throw little or no stress on the yarn.

The rollers for *reducing* or *drawing* the roving in the mule are similar to those of the throstle, a number of heads being coupled together. The spindles (of which there are now usually about 300 in one mule) are like those of the *common* jenny, having neither bobbins nor flyers. They are disposed and revolve on a carriage, which recedes from the rollers, while the thread is delivering.

For many years the mule was worked entirely by hand; but now the whole of its operations, excepting the returning of the carriage, and the building the thread on the spindles, is performed by power. We shall, as in other occasions, confine our attention principally to trace the progress of a single thread.

Plate CCXIV. Fig. 8.

In Fig. 8. A represents a roving placed in a frame behind the drawing rollers CDE. After passing from between the rollers, the reduced roving goes on to the spindle F, which is placed a little inclining. The spindles are disposed on the carriage FGHI.

The machine being put in motion, the carriage recedes as fast as the rollers deliver the reduced roving; the spindles at the same time rapidly revolving, giving sufficient twist to the yarn to bear *stretching.* After the rollers have delivered a certain length (a yard, for example) of yarn thus partially twisted, they stop, but the carriage continues to recede, (half a yard further, for example) and the spindles to revolve. The yarn is thus *stretched,* and forms a fair even thread. In order to save time, the spindles move more rapidly during the process of *stretching.* The mechanism, by means of which this increased rapidity is effected, is called the *double-speed.*

The yarn being sufficiently hard twisted, the machine disengages itself from the rest of the moving parts of the mule. The attendant then returns the carriage home to the rollers. With one hand he manages the fly-wheel, and by it the movement of the spindles; while, with the other, he directs the wire *a* of the folder *a b,* (which turns on a pivot at *b,*) so as to build the thread on the spindle in a conical form, denominated a *cop.*

The spinner, from habit, communicates the motion of the handle, so as to keep the threads always at that degree of tension, which, without injuring the thread, will make the cop firm and compact.

These several operations being repeated until each of the spindles has a cop on it of a proper bulk, they are then taken off to be reeled, which is done in the same manner as we have already described of the water-twist. The cops, indeed, are often used without being reeled, particularly for weft; and, on other occasions, the yarn for warp is wound off the cop immediately on the warping bobbins.

The Stretching Frame.

Stretching frame.

We already observed, that the rovings for mules commonly receive their last reduction previously to the spinning, on what is called the *stretching frame.* The *construction* of this machine, excepting in its proportions, is the same as the mule. The spindles, in order to give room for larger cops, are more distant from each other.

But although its *construction* be the same as the mule, its *operation* is different, in as far as it does *not stretch* in the sense to which we have confined that word, but merely reduces the rove by the process of *drawing* by means of the rollers.

Description of the buildings, &c.

Having thus attempted a description of what is called the *small* machinery of cotton-mills, we shall say a little with regard to the mill-work, or *great gear,* and the buildings which contain the whole, beginning with those for spinning water-twist.

This species of yarn, as already observed, is spun for the most part in those situations, where there is water sufficient for driving the machinery.

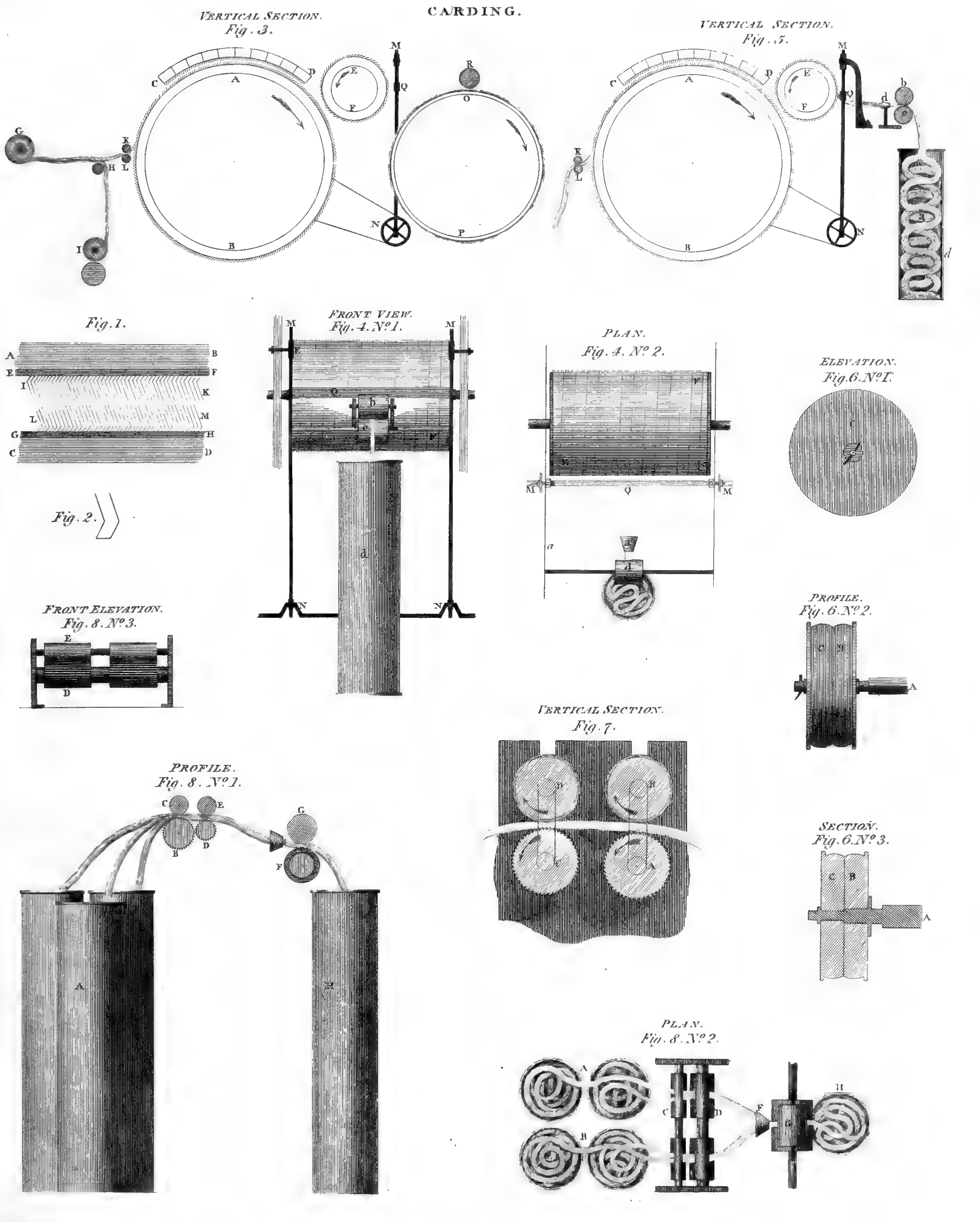
The buildings are usually five or six stories high, and from 28 to 33 feet wide. Their length depends much on the number of spinning frames contained in one floor.

A large water-wheel is usually placed in the middle of the lower part of the building. In some cases, strong lying-shafts convey the motion from rings of teeth attached to the water-wheel, to each end of the ground-floor. These lying-shafts give motion to an upright shaft, opposite the abutment of each window; and the whole is supported in the lower story by strong framing, independent of the wooden floors, so that much of the tremour of the great gear is thus confined to the framing. The upright shafts passing up through the spinning rooms, have a drum opposite to every two spinning frames, to which, by a leathern belt, it gives motion. A few of the upright shafts are continued up to the carding rooms, and give motion there to the preparation machinery.

In other cases, the water-wheel, having teeth on it, moves two strong upright shafts, conveying the motion to the stories above; and, from crown-wheels on them, lying-shafts are worked, that convey motion to the drum-shafts in the spinning rooms, and other lying-shafts to the preparation machinery. In the first of these cases, the stair is usually placed at one end of the building; in the second, in the middle. This last arrangement is most generally adopted.

In order to prevent the risk of fire, it is usual to conduct in out-houses all the business which does not require machinery worked by power; and some even prefer, on that account, to have the preparation machinery in a separate building.

To describe more particularly the many ingenious contrivances in the construction of mill-work and buildings of an extensive set of cotton works, would exceed the limits which we have assigned to this article. (O)



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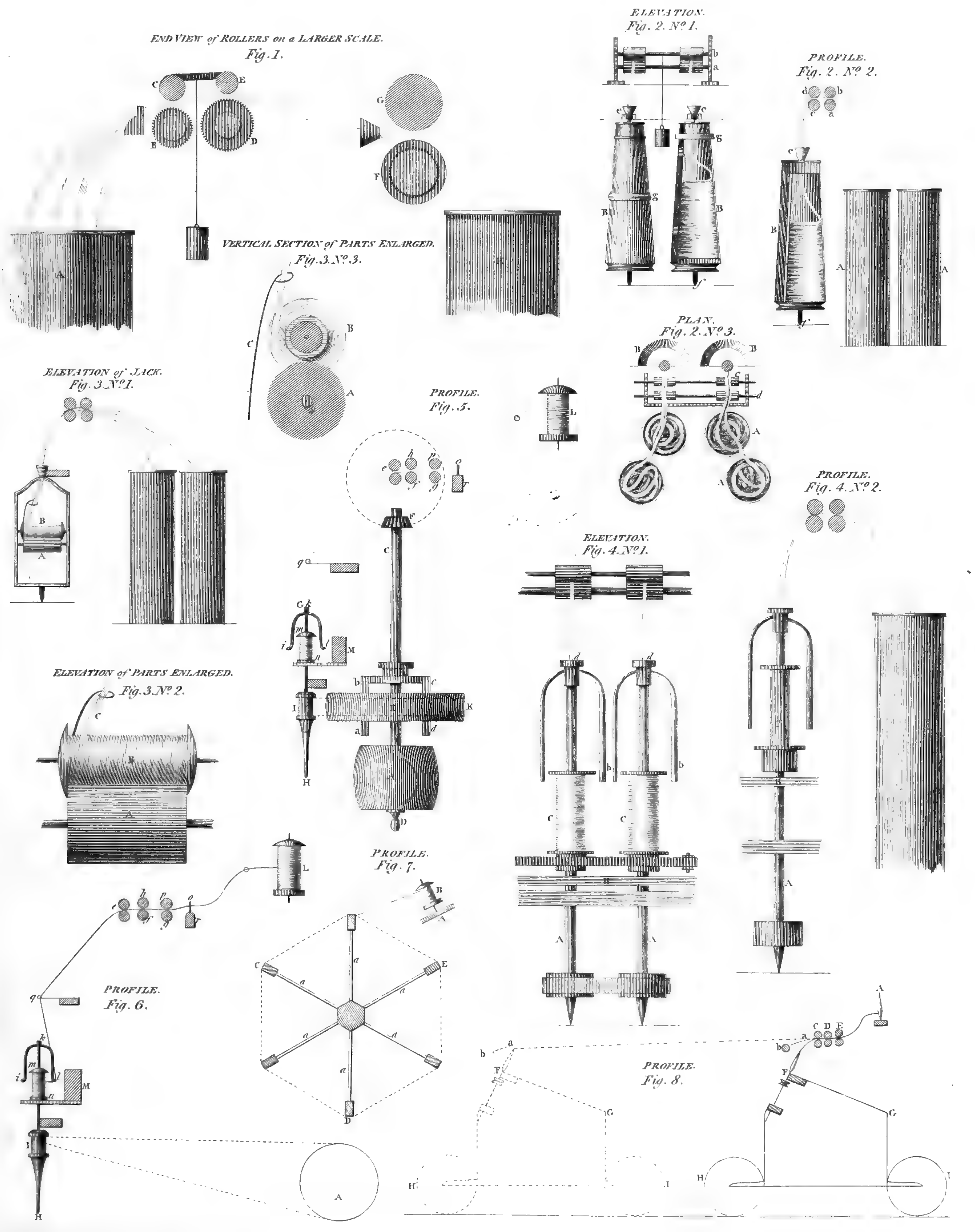
COTTON SPINNING. PLATE CCXIV.



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COTTUS. See ICHTHYOLOGY.

COTULA, a genus of plants of the class Syngenesia, and order Polygamia Superflua. See BOTANY, p. 297.

COTYLEDON, a genus of plants of the class Decandria, and order Pentagynia. See BOTANY, p. 219.

COTYLEDONS. See BOTANY, vol. iv. p. 36, 47.

COUBLANDIA, a genus of plants of the class Polyandria, and order Monogynia. It is placed by some botanists in the class Monadelphia, and order Polyandria. See BOTANY, p. 241.

COUCHING. See EYE and SURGERY.

COVENANT, in the English law, is a species of contract, whereby a party to a deed agrees to do or omit some direct act. The remedy for a breach of such contract is by a *writ of covenant;* by which process the plaintiff may recover damages, in proportion to the injury which he has sustained. In the case of a covenant *real,* to convey or dispose of lands, the remedy is by a special writ of covenant, for a specific performance of the contract, concerning certain lands particularly described in the writ. It is upon this process, that *fines* of land are usually levied at common law. See FINE. (z)

COVENANT, in Scottish history, is the name given to a solemn engagement entered into by the people, for the preservation of the national religion. Its origin may be traced to the reformation; and the name was evidently adopted from the frequent covenants of Israel with God. During the progress of the reformation, the covenant was twice renewed; and it was at length revived in a more permanent form, by the *Tables,* or commissioners from the different orders of *Supplicants,* against the canons and liturgy of the English church, in the reign of Charles I.

This memorable deed was prepared by Alexander Henderson, the leader of the clergy, and Archibald Johnston, afterwards of Wariston, an advocate, in whom the supplicants chiefly confided, and revised by the Lords Balmerino, Loudon, and Rothes. It contained a general profession of the reformed religion, and a minute abjuration of the rites, ceremonies, doctrines, and whole discipline of the Romish church; and enumerated a variety of statutes, to vindicate the renewal of this intolerant confession of faith. A bond of union was subjoined, containing a declaration, that the liturgy and canons, as if expressly prohibited, were virtually renounced in the confession of faith; and concluding with an obligation to resist those innovations, to defend each other, and to support the sovereign in the preservation of religion, liberty, and law. On the 1st of March 1638, this covenant was subscribed and sworn in the Grey Friar's church at Edinburgh, by the nobility, gentry, clergy, and burgesses. Copies were immediately circulated throughout the different parts of the kingdom, and within a short space of time, it was embraced, with the most ardent enthusiasm, by almost the whole of Scotland. In the year 1643, the famous *Solemn League and Covenant* was concluded between the Scots and English, with the view of uniting the two kingdoms by the bond of religion.

In 1660, the covenants were virtually repealed by the general *rescissory* act; and, in 1663, a declaration was passed by the parliament, to abjure the covenant under severe penalties. See Laing's *History of Scotland;* and the article SCOTLAND in this work. (z)

COVENTRY, a city of England in Warwickshire, in Lat. 52° 24′ 26″.3 N. and Long. 1° 30′ 5″.5 W. from Greenwich Observatory, as accurately determined for the spire of St Martin's church in 1790, in the course of the trigonometrical survey carrying on by the royal engineers. This city is 91 miles N.N.W. from London, and 49½ miles N. of Oxford, situated on a gentle rising ground on the river Sherburn. It is both a city and county within itself, sending two representatives to the House of Commons; having a weekly market every Friday, and an annual fair of eight days, commencing on the festival of the Holy Trinity.

Its scite is chiefly on a remarkable stratum of red sand, in some places hardened into stone; whence, at no great distance to the N.W. the coal strata begin to crop out to the day. The tillage lands in the neighbourhood contain great numbers of rounded quartz pebbles, black, deep red, brown, white, and veined, from the size of an egg to that of the fist, and with which the streets are paved; and in the neighbourhood there is a quarry of soft grey stone, easily reduced to sand, which serves the inhabitants for various domestic purposes, and for mixing with lime mortar.

Having never suffered considerably by the ravages of fire, the city still bears strong marks of antiquity, in its narrow, dark, and winding streets; and many of its more ancient houses hang forwards so much, as almost to meet above from opposite sides of the way, through the absurd projection of their several stories beyond each other as they rise in height. It contains three parish churches, all standing in the same cemetery, in which also there formerly stood a cathedral, now in ruins. The steeple of the church of St Michael is reckoned one of the finest in Europe, all its parts being in the truest proportions to each other, insomuch that it was reckoned a masterpiece in architecture by the celebrated Sir Christopher Wren. The body of this beautiful church was partly rebuilt in 1434. The steeple, which is 303 feet high, was begun in 1372 by two brothers, Adam and William Batoner, who expended upon it L. 100 yearly, for 22 years; and it had to be afterwards completed by two ladies of the same family. The tower is richly ornamented with niches, containing statues of saints; and the taper spire rises majestically from an octagonal base. Besides the three established churches, there are five places of worship belonging to various denominations of dissenters, a Quaker meeting-house, and a Roman Catholic chapel.

There was formerly a monastery of Grey Friars, and a beautiful octagonal tower and spire remain on the south side of the city, formerly belonging to their church.—These friars were celebrated for performing sacred mysteries, or pageants so called, to the people on the day of *Corpus Christi,* which they exhibited on a moveable stage in different parts of the city; their scenes or interludes amounting to about forty, representing various stories from sacred writ, from the creation down to the final judgment. The Grey Friars' hospital was founded in 1529, by William Ford, merchant, and augmented by his executor William Pisford, and subsequently by other benefactors. In this, fourteen poor aged persons are maintained, for whom also a nurse or female attendant is provided. St John's Hospital, in Bishop Street, was founded in the reign of Henry II.; and in that of Henry VIII. became the property of John Hales, who left an estate of L. 43 a year, since greatly improved, to

Coventry. endow a free school, which is now held in an aisle of the chapel.

The Carmelites, or White Friars, had also a monastery and church at this place, founded in 1342, by Sir John Poultney, who had been four times lord mayor of London. There was likewise an hospital for lepers, founded by Hugh Earl of Chester, the ruins of the chapel and gate-way of which still remain. Bablake Hospital was founded in 1506, by Thomas Bond, mayor, in which he placed ten poor men, a woman to take care of their bodies, and a priest to superintend their spiritual concerns. At the suppression of the religious houses, Edward VI. vested its revenues in the corporation, which now supports there eighteen old men, with a nurse or matron. Part of the same building is appropriated for the residence of a number of poor boys, on a foundation instituted by Thomas Wheatly, mayor, ironmonger, and wool-card maker, in consequence of the following singular incident. Having sent his servant to Spain, in 1556, to purchase some barrels of steel gads, or ingots; he bought, by some inexplicable mistake, and brought home, a number of casks filled with ingots of silver and cochineal, which were offered for sale in an open fair, as the articles he was directed to purchase. His worthy master made afterwards every effort to discover the person who sold these, but ineffectually; and finally, converted the whole value, together with all his own property, to the establishment of this charity.

This city boasted formerly of a beautiful cross, 57 feet high, and richly ornamented, which was erected between 1541 and 1544, by Sir William Hollis, lord-mayor of London. After becoming greatly mutilated, this has been lately entirely removed.

St Mary-hall, near the church of St Michael, a magnificent structure, was erected in the reign of Henry II. The great room has a large window at the north end, containing in nine divisions, the whole length effigies of nine English kings, with various armorial bearings; and the windows on the east side contain portraits of many eminent persons, formerly members of the Trinity gild, who became possessed of this hall on the union of the two gilds. Draper's hall is a handsome modern structure, ornamented with Tuscan pilasters.

Coventry has long possessed rich and flourishing manufactures. Anciently, the chief of these were cloth, and caps, or bonnets, which flourished here from before 1346 till the eighteenth century, when the cloth manufacture was transferred to Yorkshire, that of bonnets having long expired through the prevalence of hats. In a later period, shags, tammies, camblets, lastings, and other woollen stuffs were manufactured here to a great extent. On the decline of these, the manufacture of silk ribbands was introduced about an hundred years ago, and is now carried on to a vast extent in the city and neighbourhood. Before 1581, this city was celebrated for the manufacture of thread, the excellence of the blue thread made and dyed there being almost proverbial; but the art seems now lost.

Though an inland city, Coventry enjoys great facilities for trade and manufacture, by means of the Coventry and Oxford canals, which join the Grand Junction and Grand Trunk canals, affording communications with London, Liverpool, and Hull, and serving for the conveyance of coals from the coaleries of Hawksbury and others. The Coventry canal terminates on the top of a steep hill a little above the town, where two parallel branches, or basins, include a spacious yard between them, for the landing and stowage of coals, lime, timber, and other rough and bulky commodities. The canal basins are skirted by embanked wharfs, raised so far above the level of the yards, that carts and waggons, backed up against them, have their bottoms nearly on a level with the wharfs and gunwales of the loaded boats, affording the utmost facility and dispatch for loading and unloading. At one place, the bank or wharf is occupied by a range of warehouses, having penthouse roofs projecting over the boats, which can thus be loaded or unloaded safely in any weather. At intervals there are gateways communicating with the wharfs, yards, and warehouses; and in one of the gateways is a weighing machine, for ascertaining the loads of coals or other heavy goods. Coventry.

About two miles and a half from Coventry, the canal is carried over the river Sow and its valley by an aqueduct bridge and considerable embankment; and half a mile south-east of Bedworth, it is conducted through the grand central ridge of England, by an immensely deep cutting in a stratum of red clay. A branch and rail-way proceed from Shackleworth bridge to the coaleries at Bedworth town, which are 120 yards deep. Sir Roger Newdigate's canal branches off on the north-west of the summit before mentioned, and, after rising by several locks, crosses the same summit again at a higher level before entering his park. About a mile from Coventry, a meadow is occasionally irrigated by the waste water of the canal, discharged over a slope in the bank, or a trunk through its thickness; a practice which may be imitated to great advantage in many similar situations.

In the Saxon Chronicle, the name of Coventry is Couentre; and in some of the old monkish historians, it is called Couventria. Antiquaries have derived the name from *coven*, quasi *convent*, and *tre*, a British word signifying *town*, as if the Convent-town; a strange conjunction of different languages, scarcely admissible. Others have supposed, that the original name of the river Sherburn may have been *Cune*; and thence *Cune-tre*, changed to *Coventry*, signifying the town on the Cune. The convent to which this city is supposed to have owed its name, is said to have been anciently possessed by nuns under the governance of a holy abbess, St Osburga. However this may have been, it appears to have been destroyed in 1016, during the invasion of Mercia by Canute. On its ruins, Leofric, Earl of Mercia, founded a new monastery in 1043, for an abbot and twenty-four Benedictine monks. According to William of Malmsbury, this monastery was afterwards so much beautified and enriched, that Robert de Limesie, bishop of the diocese in the reign of William Rufus, is said to have taken 500 marks of silver from one beam that supported the shrines.

Leofric married the lady Godeva, famous in legendary story; who, compassionating the oppressions suffered by the inhabitants from their lord, incessantly solicited in their favour, till at length, wearied by her importunities, he peevishly agreed to grant them a charter of immunities, on condition that she would ride naked through the town, in sight of all the people. To this she consented, modestly accomplishing the indecent task, by covering her naked person by means of her flowing tresses, and thus obtained a charter of freedom for the townsmen. Long afterwards, in the reign of Richard II. the grateful inhabitants placed portraits of Leofric and Godeva in one of the south windows of the church of the Holy Trinity, representing the Earl holding out the charter, with an in-

Coventry. scription, or scroll, addressed to the Countess, in the following words:

"I Luoricke, for the love of thee,
Do make Coventry toll free."

Others assert, that Leofric, repenting of his rash and indecent proposal, commanded every one of the inhabitants to retire from the streets and fronts of the houses during the progress of the lady, under pain of death; but that one curious person contrived to have a glance at the naked countess, from which he obtained the name of *Peeping Tom* of Coventry, and the honour of a statue in the act of looking from a window in one of the streets. It is certain, however, that this event is annually commemorated by a procession, in which the naked figure of a woman is paraded through the streets on horseback. In the last edition of Cambden's *Britannia*, by Gough, there is inserted a dissertation by Dr Pegge, to prove that this is a mere legendary story, resting on no historical document.

In the reign of Edward III. the citizens were allowed to build an embattled wall of stone around the city, for which they had a grant of six years toll on the wine, malt, oxen, hogs, calves, and sheep, consumed within the city. The first stone of this wall was laid in 1355, and it was afterwards completed with great strength and magnificence, being defended by 32 towers and 12 gates. Great part of the wall, most of the towers, and several of the gates, were ordered to be demolished in 1661, by Charles II. as a punishment for refusing admittance to Charles I. in 1642, and adhering to the parliament during the civil war.

Henry IV. held a parliament at this place in 1404, which old historians denominate *parliamentum indoctorum*, because all persons learned in the law were expressly excluded from seats, or because its acts were considered by the clergy, the historians of the age, as hostile to their interests and immunities. Another parliament held here in 1459, by Henry VI. was called *parliamentum diabolicum*, because of the numerous attainders it passed against the adherents of Richard Duke of York.

Previous to the Norman conquest, the diocese of Litchfield and Coventry included Chester, and after that event the see was removed to Chester. In the reign of William Rufus, the see was again restored to Coventry, where the bishops had a palace, no vestige of which now remains. At present the residence of the bishop is at Litchfield, and Chester is a separate bishopric. In the king's books, the bishopric of Litchfield and Coventry is rated at L.2800 yearly.

The population of this city was returned as 16,034 persons, of all ages and both sexes, in 1801, under the authority of parliament, though former calculations led to an estimate beyond 20,000, and some have even computed the number at 25,000. It is said to have contained 15,000 in the early part of the reign of Henry VIII.; but to have suffered so severely by the dissolution of its priory and monasteries, as to have been reduced in the reign of Edward VI. to 3000; but, by an exact enumeration taken in 1520, and recorded in the city leet book, the population was then 7000. About 3000 of the inhabitants are free burgesses, having votes in the election of two representatives to parliament.

The following abstract of the population of the *city of Coventry* is taken from the recent returns for 1811.

Inhabited houses,	3448
Families that occupy them,	4096
Houses building,	12
Uninhabited houses,	50
Families employed in agriculture,	123
Ditto in trade, manufactures, &c.	3207
Families belonging to neither of these classes,	766
Males,	8197
Females,	9726
Total population,	17,923

Coventry | Coulam.

The *county of the city of Coventry* includes the parishes of Anstey, Exhall, Foleshill, part of Sow, Stivichall, Stoke, and Wighen, and also the hamlet of Keresley.

The following abstract of the population of this county is also taken from the returns for 1811.

Inhabited houses,	1196
Families that occupy them,	1263
Houses building,	2
Uninhabited houses,	44
Families employed in agriculture,	290
Ditto in trade, manufactures, &c.	851
Families belonging to neither of these classes,	122
Males,	2554
Females,	3310
Total population,	5864
The united population of the city and county of Coventry is	23,787

For more ample accounts of the antiquities, and the ecclesiastical and civil history of Coventry, Dugdale's *Warwickshire*, Gough's edition of *Britannia*, and Pennant's *Journey from Chester to London*, may be consulted. (KK)

COUGH. See MEDICINE.

COULAM, or COVALAM, the *Colis* or *Colias* of the ancients, is a small town of Hindostan, situated on the western side of Cape Comari. The ruins of the fortress, which formerly belonged to the Imperial East India Company at Ostend, are now the retreat of a multitude of snakes. A great number of very beautiful shells are cast on shore here by the sea. The principal productions of the place are millet and salt, the latter of which may be collected by the Christians as well as by the Pagans, the former of whom are very few in number, while the town abounds with Mahometans.

On the sea-coast between Coulam and Sadras, are situated seven temples, which are reckoned masterpieces of ancient Indian architecture, being cut out of the hardest rock, in a mountain covered with trees. The entrance fronts the sea, and is excavated from the solid rock, which forms part of the summit of the mountain. It is 20 Roman palms broad, and 15 high, and has its sides covered with the figures of various sacred animals as large as life, such as the elephant of Rama and Gannesha, the tortoise of Vishnu, the ape of Rama, the wild sow into which Vishnu metamorphosed himself, the cow of the goddess Parvadi and Lakshmi, the fish as the symbol of water, the snake as the symbol of life and death, and various other animals. At the end of this passage there is a small round place in the same rock, where there is seen on the left a few stone steps, and on the right two passages, also cut out of the rock, each of which were about seven palms broad and twelve high. These steps and passages conducted to the temple, which consisted of extensive apartments, or caves, with vaulted roofs, and separated from one another by walls hewn from the solid rock. They are all supported by pillars cut out of the rock, the largest apartments being below, and the smallest above. A very great number of colossal statues, hewn out of stone masses, are placed around the walls. Among these are the gods Brahma, Vishnu, Sheva, Rama, Krishna, Devendra, Kartiguna, and Gannesha, and the goddesses Parvadi, Sarasvadi, and Lakshmi, and the nine different forms into which Vishnu had transformed himself while on earth. Some idea of these temples may be formed from inspecting Plate CLI. of Civil Architecture. A minute account of the sculptures and ruins, of which the above is a very general description, will be found in the first volume of the *Asiatic Researches*, by William Chambers, Esq. See also Bartolomeo's *Voyage to the East Indies*. (*j*)

COULOMB, Charles Augustus, a celebrated mechanical philosopher, was born at Angouleme on the 14th of June, 1736, and was descended from a family which had been distinguished in the magistracy of Montpellier. Having been taken to Paris at an early age, he acquired a decided taste for the mathematical sciences; and with the view of making his knowledge subservient to his promotion, he entered into the corps of military engineers. About this time he went to Martinique, where he was employed by government in several important works; but the insalubrity of the climate, which had already proved fatal to all his companions, compelled him to seek for health in his native country, to which he returned, after an absence of nine years. The first memoir which he laid before the academy was on a subject connected with his profession, and obtained for him the title of a corresponding member. It was published in a separate work, entitled, " *Re sur les moyens d'executer sous l'eau toutes sortes de travaux hydrauliques sans employer aucun epuisement*," and was written for the prize proposed by the academy of Rouen in 1778. A second edition of it was published at Paris, in 1797. In the year 1779, he divided with M. Van Swinden, the learned author of the *Positiones Physicæ*, the prize for the best construction of the magnetic needle, and in the year 1781, he carried off the prize proposed by the academy on the theory of simple machines.

This valuable memoir, which was published in the *Memoires des Savans Etrangers*, tom. x. p. 163. contains a series of admirable experiments on friction, and on the stiffness of ropes. The subject of friction, which had been treated very imperfectly by Amontons, Bullfinger, and Euler, was here investigated with a degree of ability and success which widely extended the reputation of Coulomb. By using ponderous weights, and by conducting all his experiments on a very large scale, he has obtained results equally new and interesting. One of the principal results which he obtained relates to the effect of time in modifying the friction of one body upon another. The friction sometimes reached its maximum after the rubbing surfaces had been only one minute in contact, and in other cases the maximum effect was not produced till they had been in contact for five or six days. When a body weighing 1650 pounds was laid upon its corresponding surface, it was put in motion by a weight of 64 pounds; but when the contact was continued for three seconds, the force required to move it was 160 pounds; and when the contact was continued for six days, it could with difficulty be moved by a force of 622 pounds. These experiments were made at Rochefort, where M. Coulomb then resided; and from the naval arsenals which were under the charge of M. La Touche-Treville, he obtained every assistance that could facilitate his researches.

In consequence of the competition for the prize on the subject of the magnetic needle, the attention of our author was turned to the subject which has been the principal foundation of his fame. One of his antagonists having pointed out a method of removing the effect of torsion, or the resistance which is opposed to the magnetic force by the stiffness of the suspending wire, Coulomb applied himself to investigate the effects of torsion, and invented a machine for measuring it with precision. These researches are contained in two memoirs which were published in the Memoirs of the Academy, under the title of *Recherches Theoriques et experimentales sur la force de Torsion, et sur l'elasticité des fils de Metal.** In these experiments Coulomb employed a very simple apparatus. A metallic wire suspended vertically, was firmly fixed at its upper end, and its lower end was fixed into a cylinder, also vertical, and having a horizontal index. By turning the cylinder about its axis the wire is twisted, and when let go, it endeavours, in virtue of its elasticity, to recover its form. The index will therefore oscillate round the axis of the cylinder. The force which produces these oscillations is called the *force of torsion*, and the angle measured by the arch which the index describes, the *angle of torsion*. After having deduced the formulæ for the oscillatory motion of the cylinder, on the supposition that the reaction of the force of torsion is proportional, or nearly so, to the angle of torsion, Coulomb proceeds to determine by means of these formulæ, the laws of the force of torsion relative to the length, the thickness, and the nature of the wires which were used; and from a great number of experiments, he obtained the following results:

1. For all metallic wires, when the angles of torsion are not very great, the force of torsion is sensibly proportional to the angle of torsion.

2. The duration of the oscillations is as the square roots of the weights of the oscillating cylinders.

3. The times of the same number of oscillations are as the square roots of the lengths of the wires.

4. The momentum of the force of torsion varies as the fourth power of the diameters of the wires; and,

5. In metallic wires, the momentum of torsion is directly in the compound ratio of the angle of torsion, and the fourth power of their diameter, and inversely as the length of the wire.

In the year 1781, Coulomb arrived in Paris, and was immediately elected a member of the Academy. His attention was now directed to the subject of electricity and magnetism; and the rest of his life was employed in this important investigation. By a series of delicate experiments, he demonstrated that the attraction of magnetism is inversely as the square of the distance. He improved the dipping needle and the common magnetic needle, and with the aid of theory, he gave a new degree of perfection to the method of making artificial magnets. The most important, however, of all his results, relates to the effects produced upon the magnetic action

* See *Mem. Acad. Par.* 1784. p. 229.

Coulomb. by difference of temperature. He found that it diminishes as the temperature is increased; and with the assistance of a theorem by M. Laplace, he found that a magnetic needle must acquire a temperature of 700° of the centigrade scale, before it is entirely deprived of its magnetism. It had long been believed that iron was the only body that possessed the magnetic virtue, but Coulomb found unequivocal marks of attraction in almost all bodies that he tried; and hence he concluded, that magnetism, like electricity, was extended through all nature. This discovery was the last which he made, and his latest moments were employed in verifying it. Several curious experiments have been found among his manuscripts, from which it seems to follow, that if the magnetical attractions, which he discovered in different bodies, were owing to the presence of iron, the quantity of this metal must be so considerable, that it could not have escaped the notice of chemists.

The attention of Coulomb having been particularly directed to the subject of wind-mills, he published the results of his researches in the Memoirs of the Academy for 1781, under the title of *Observations Theoriques et Experimentales sur l'effet de Moulins a vent, et sur le figure de leurs ailes.* These experiments were made upon more than fifty wind-mills in the neighbourhood of Lisle. He found that almost all of them performed nearly the same quantity of work when the wind moved with the velocity of 18 or 20 feet per second, and from this he justly concluded, that the parts of these machines must have been so adjusted as to produce nearly a maximum effect.

In the latter part of his life, Coulomb was appointed commissary to the king in Bretagne, and was sent by the minister of the Marine to examine the canals and public works in that province. On this occasion, it required all the energy of his character to stop the ruinous projects which had been on the eve of execution; and the province, out of gratitude for his services, rewarded him with a very considerable present.

At the commencement of the revolution, Coulomb resigned almost all his offices, and particularly the general superintendance of the fountains of France, which had been hereditary in his family, and which he had hoped to transmit to his children. He employed himself in collecting the wrecks of his fortune; and expected to find, in the continuance of his scientific labours, and in his correspondence with the Academy, that happiness of which external circumstances could not deprive him. The Academy, however, was suppressed, and his situation as member of the Commission of Weights and Measures was taken from him. He was soon after compelled to leave Paris, by the edict which expelled all the nobles; and he retired with his friend the Chevalier Borda to a small estate which he possessed near Blois. In this retreat, he pursued, in the bosom of his family, those studies which had in better times occupied his mind. His attention was accidentally directed to the subject of vegetation, and he made some experiments on the motion of the sap, of which he has given a short account in a paper published in the *Memoirs of the National Institute,* tom. ii. p. 246, under the title of *Experiences relatives a la circulation de la seve dans les arbres.* The result of these experiments, which is however proposed merely as a conjecture, is, that the circulation of the sap in vegetables is carried on by the parts adjoining to the central canal of the tree, and by the infinity of medullary horizontal radii, which form a communication with the axis of the plant. Coulomb.

In the year 1798, Coulomb read to the national Institute a long and valuable paper, entitled *Resultat de plusieurs experiences destinées à determiner la quantite d'action que les hommes peuvent fournir par leur travail journalier, suivant les differentes manieres dont ils emploient leurs forces.* In this elaborate paper, which consists of thirty sections, the object of the author is to determine how much loads of different magnitudes may diminish the quantity of action which a man can furnish in a day; and the experiments which were employed for this purpose, were made upon the most natural and ordinary motions of men, such as walking horizontally, or mounting a ladder. He found, that the load which a man ascending stairs should carry, in order to produce the greatest useful effect, is 173.8 pounds avoirdupois, on the supposition, that he is to continue the exertion during a whole day. In this case, the quantity of action which the labourer exerts is 183.66 pounds avoirdupois, raised through 3282 feet. Coulomb then proceeds to compare the total quantity of action which a man can furnish when ascending steps, with that which he exerts in driving a winch, in digging the ground, in pulling a rope horizontally, and in walking on a level road; and the general results of these comparisons, give quantities of action much less considerable than those which had been employed by all preceding authors in their calculations of machines. Coulomb also found, that the mean quantity of action depended greatly on the food, as well as on the climate; and that in warm climates, such as Martinique, where the labourer is almost always inundated with perspiration, the quantity of action furnished by one man is scarcely one-half of that which is furnished in France.

The subject of magnetism continued to occupy the thoughts of Coulomb, and he produced a very valuable paper in 1800, which was published in the Memoirs of the Institute, tom. iii. under the title of *Determination Theorique et Experimentale des Forces qui ramenent differents aiguilles aimantées a saturation, a leur meridien magnetique.*

In the same volume of the Memoirs of the Institute, he published one of the most curious of all his papers on the cohesion of fluids. It is entitled, *Experiences destinées a determiner la coherence des fluides et les lois de leur resistance dans les mouvements tres lents.* In these experiments, Coulomb employed the principle of torsion, for determining the cohesion of fluids, and the laws of their resistance, in very slow motions. Newton, D. Bernoulli, and Gravesende, represent the resistance which a fluid at rest opposes to a body in motion, by a formula of two terms, one of which is as the square of the velocity, and the other constant; but Coulomb has shewn, by unquestionable experiments, that the resistance is represented by two terms, one of which is proportional to the simple velocity, and the other to its square, and that, if any constant quantity exists, it is extremely small. He proposed, in a subsequent memoir, to ascertain numerically, the part of the resistance which is proportional to the single velocity, and to determine the resistance of globes, with convex, concave, and plain surfaces; but this second memoir was never published.

From his state of exile Coulomb was afterwards recalled to Paris, to resume his labours relative to the new measures; but he did not remain long in that metropolis. He was pressed to rejoin his wife and family, and to take charge of the small property which was their only resource; and he did not again return to Paris till the establishment of the National Institute, of which he was elected a member. His health, too, which had long been in a declining state, required the assistance of art; and he suffered extremely from the effects of a nervous temperament, which produced a vivacity of character, and an impatience of temper, which he found it very troublesome to restrain.

He was now appointed one of the inspectors general of studies; an office which he accepted after much hesitation, but which he filled with great credit and usefulness. The general debility with which he was afflicted, was now greatly increased by a slow fever, which threatened his existence, and which reduced him so much, that he was unable to take any nourishment. The skill of his medical friends was employed in vain, either in assuaging his distress, or in restoring his health; and he died on the 23d August 1806, at the age of 70, leaving behind him two sons, with no other inheritance but that which was derived from the virtues and the talents of their father.

The public as well as the private character of Coulomb were universally admired. In the various relations of domestic life, he conducted himself with the utmost prudence and affection. Severe to himself, and indulgent to others, he united the most easy manners with a gravity of character which inspired respect. He was unassuming, generous, and disinterested, without possessing any of the failings by which these virtues are frequently obscured.

Beside the works which we have had occasion to mention, Coulomb wrote an able dissertation on the force of steam, which was read to the academy in 1775, and published in their memoirs; and he intended, at the earnest request of his scientific friends, to collect all his memoirs into a separate volume. He had proceeded so far in this work, as to transmit to his bookseller a note, containing the order in which he wished them to be printed.

The English reader will find an account of several of Coulomb's experiments on windmills, and an abstract of his experiments on friction, in Ferguson's *Lectures*, vol. ii. Appendix; and in our articles Electricity, Hydrodynamics, Magnetism, and Mechanics, we shall have frequent occasion to follow him in his career of discovery. (*w*)

COUNCIL. See Ecclesiastical History.

COUPANG, a town in the island of Timor, is the capital of what was formerly the Dutch part of the island, and is situated on the south-west end of the island, at the bottom of a deep bay, which affords excellent anchorage for shipping. There is a fort here, called Concordia, where all the Europeans reside. It is close to the water's edge, and was built by the Dutch in 1613, when they expelled the Portuguese from that part of the island. The Chinese and the natives reside in a village without the fort. There is a small fresh water river to the east of the fort, which is navigable for a long boat at high water. The governor of Coupang has authority over Rotti, Savu, and some of the other adjacent islands. The Dutch districts in Timor were lately taken possession of by the English. The only trade carried on at Coupang is with Batavia, from which the Europeans obtain necessary articles, and a small quantity of piece goods, iron, steel, opium, &c. The exports to Batavia, which are given in exchange for these commodities, are slaves, gold dust, and wax. China weights are in common use at Coupang, and Dutch money passes here as at Batavia. East Long. 124° 5′, South Lat. 10° 9′. (*w*)

COURLAND, the Duchy of, in the ci-devant kingdom of Poland, is bounded on the north by the gulf of Riga, on the west by the Baltic sea, on the east by Lithuania, properly so called, and on the south by Samogitia. It stretches in length about 250 miles, and its average breadth may be estimated at about 60 miles. It is in breadth, indeed, very irregular, extending in some places 80 miles, in others scarce 30, and towards the east terminating in a point. It is situated in E. long. between 21° and 26°, and between 56° 30′ and 57° 30′ N. lat. constituting now a province of Russia, and one of its great divisions subject to a distinct jurisdiction.

The duchy of Courland is divided into three parts, viz. Courland properly so called, Semigallia, and the district of Pilten. The latter of these has its own particular constitution. Courland and Semigallia are divided into great governments, and these again into circles or districts called parishes.

The duchy of Courland swells into gentle hills. The soil is fertile, producing corn, hemp, and flax, in abundance. The country for the most part is open, but in some places it is clothed with forests of pine and fir. There occur also occasionally groves of fine oak, and there is no want of shrubs and underwood. Courland is noted for its breed of horses: black cattle also are reared in plenty; and the country is frequented by a great variety of wild animals, such as deer, bears, lynxes, wolves, martens, elks, and others.

Courland exports a great part of the produce of its soil, its corn, hemp, and flax. Besides these there are various other productions, which, either in a natural or prepared estate, may partly be disposed of abroad, such as its timber, masts for ships, potass, skins, turpentine, wax, amber, iron, copper, chalk, &c.

In return for these articles, Courland imports coffee, tea, wines, cloth, salt, and other foreign merchandise, in sufficient quantity to supply the internal consumption. The hemp seed of Courland, which is sent out of the country in great quantity, is the most esteemed of all the seed of this kind that is obtained from the north. The Dutch have been accustomed to make oil of it; and it has been usually sown throughout Flanders and France, as well as pretty generally in other parts of Europe. The Dutch alone have been in use to send not less than 25 vessels annually into Courland, on account of this trade. The situation of the duchy on the Baltic sea is very favourable for the prosecution of its commerce. The principal ports, Libau, and Windaw, have no great depth of water. The inhabitants of these two cities have, however, been in the practice of sending out many vessels to sea. Under their duke Jacob, some of those ships proceeded as far as to America, and colonies were established by this people in the island of Tobago. The two ports together employ annually from 800 to 1000 vessels, of two, three, and four hundred tons.

The most considerable towns of Courland are Windaw, Libau, Goldengen, and Mittau. The last is the capital of the duchy. There are besides many neat villages, and the scattered cottages, and gentlemen's seats, prettily situated amid clumps of trees, give to several parts of the country a very agreeable and picturesque appearance.

The chief rivers of this duchy are the Duna, or Dwina, which taking its rise in Russia, after running a long course, finally falls into the gulf of Livonia at Riga; the Windaw, which has its source in Samagitia, and joins the Baltic Sea near to the city of Windaw; and the Aa, which taking that name where the Muss and the Memel unite their streams, passes by Mittau, and discharges itself into the gulf of Livonia. These two last rivers, which are navigable, divide the country from east to west. There are besides several smaller rivers, such as the Abau, Berse, Bartau, Mussa, Anger, and some brooks and canals, by which it is intersected in every direction.

In the duchy of Courland there are mines of copper and iron. There are also quarries of stone and of chalk, and mineral springs. Its riches, in this department, are, of course, chiefly to be looked for in the more mountainous parts of the territory.

The constitution of the goverment of Courland is rather of a complicated nature. The crown of Poland, the duke, and the diet, have their respective rights, which are so much interwoven, that a somewhat accurate inspection is necessary towards ascertaining precisely the just boundaries of each of those divisions of the authority exercised in it. Courland is a male fief, dependent on and conferred by the crown of Poland. The territorial superiority of that sovereignty is settled by the *Pacta subjectionis*, or acts of vassalage, which are ratified severally by the king of Poland and the duke of Courland, at the time that the duke receives his investiture. In consequence of this territorial right, the king is empowered to invest each duke with the duchies of Courland and Semigallia, as fiefs of Poland, and to receive in return his homage, as from a vassal to his liege-lord.

When Poland is engaged in war, the duke is bound to furnish 200 horse, or 500 infantry; and the nobles 200 horse, or 30,000 dollars, in the first year of the war, provided no Polish or enemy's troops are quartered in the duchy; in each succeeding year 10,000 dollars. The money of Courland must be struck on the same standard as the coin of Poland; it is also to bear on one side the head of the king, or the arms of Poland and Lithuania: likewise the Polish money must pass current in Courland, and the Courlandish in Poland. All disputes between the duke and his subjects are to be settled by the king, who receives remonstrances from the diet of Courland against any infringement of privileges by the duke, and can order the redress of grievances. Laws tending to alter or new-model the constitution of Courland, after having been passed by the duke and diet, with a reference to the king and republic of Poland, must be finally ratified by the diet of Poland. The same diet confirms the creation of nobles, and the *indigenat recht*, or right of naturalization, recommended by the duke and diet of Courland. This is likewise the supreme court of judicature, to which any noble may appeal from the decision of the Courlandish courts of justice. In all civil causes above the value of 500 Polish florins, and in the specified criminal cases, the final decision belongs to the king and the republic of Poland. On the other hand, the Polish king binds himself to support the constitution of Courland, to maintain the duke in all his prerogatives, and the nobles and burghers in all their privileges.

In any circumstances distinct from those enumerated, and where no contradiction is involved to a feudal dependance on Poland, or no departure from the acts of subjection, the supreme authority in the duchy of Courland is vested in its own duke and diet. To the duke belongs the executive power, with the general administration of affairs; but though strictly speaking, he has the right to declare war, make peace, and contract alliances, he does not usually proceed on such occasions without consulting the diet. He has a negative on all the measures of the diet, confers the principal charges, both civil and military, has the power of pardoning criminals, and where there is no particular exception, is judge without appeal, both in civil and criminal cases. The revenues of the duke are very ample, amounting to not less than £160,000 per annum, derived from the ducal demesnes, in which are comprehended not less than a third of the duchy, from tolls and customs, manorial and feudal rights, fines, and confiscations. He is not permitted by the laws of the country to keep on foot more than 500 troops.

Of the diets, some are ordinary, others extraordinary, both being convoked by the duke, either at his own suggestion, or at the request of the nobles. With the circular letters transmitted to the different parishes for the election of the deputies, there are sent the propositions, called deliberations, which are to be laid before the diet. The deputies must be noble, and are elected by the nobles in their respective parishes. The president is chosen, after the meeting, by a majority of votes. In conjunction with the duke, the diet imposes taxes, and passes all laws and regulations, not of a fundamental kind, those themselves too being still subject to the pleasure of the Polish diet. Questions in the diets are carried or rejected by the majority; and each deputy is obliged to vote according to the instructions he has received from his constituents. At the dissolution of the diet, the deputies are bound to acquaint their constituents in person with the transactions of that assembly.

The privileges of the nobles are very great. The highest and most important officers of state are drawn from their body. They are exempted from all taxes and imposts; and any goods or merchandise imported or exported for their use pay no duty. A noble cannot be arrested for the most flagrant act but for 24 hours after the commission of the crime, unless by an order from the king and republic of Poland; he cannot be imprisoned till he is found guilty; nor can he be executed without the permission of the king and republic of Poland. The power of the nobles over the peasantry is extreme, including even what, if not altogether in appearance, is yet certainly in effect, a criminal jurisdiction over them without appeal.

By the constitution of Courland, the duke is assisted in the administration of affairs, by what is called the Supreme Council, consisting of the four high counsellors, the high steward, the chancellor, the burgrave, and the marshal. This council advises the duke as to all matters of state, guards against any infringement of the rights and privileges of the subject, and remonstrates against grievances. In conjunction also with the duke, it forms the criminal court of judicature for the nobles, to which an appeal lies from the inferior courts of justice, and which finally determines concerning all but capital offences. In cases of minority, of the absence or sickness of the duke, or on a vacancy of the ducal throne, the same four high counsellors are invested with the regency.

The prevailing religion of Courland is the Lutheran. All other religions, however, are tolerated: and by the acts of subjection already alluded to, it is provided that Roman Catholics may hold any military or civil office within the duchy, with the exception only of that of chancellor, and a few others.

The language of the native inhabitants of Courland is a dialect of the Livonian or Lettish; the same language, with little variation, that is spoken by the natives of Livonia and Esthonia, and which probably is derived from the Finnish. The nobles and gentry who are descended from German settlers, speak the German language, and it is that language which is used always in the debates of the diet.

The duchy of Courland belonged anciently to the Teutonic order, as did also Livonia. Gothard Ketler, grand master of this order, being unable to resist the Russians, who attacked and laid waste Livonia, put himself under the protection of Poland, and ceded Livonia to King Sigismund Augustus, on condition that he and his successors should retain Courland and Semigallia as a hereditary fief to be held of the crown of Poland. At Wilna, accordingly, where this treaty was concluded in 1561, the master and the principal knights having quitted the habits and ensigns of the order, the investiture of the new dukedom was conferred upon Ketler, who did homage for the same. In 1589, it was enacted by the diet of Poland, that if this fief should be vacated by the extinction of the heirs male of the line of Ketler, the territory held by them should be united to Poland. The republic of Poland was not, however, sufficiently powerful when that event took place to enforce its edict. Courland itself being too small a state to act independently of the great neighbouring kingdoms, the nomination of its dukes, as well as generally the direction of its more important affairs, has been regulated by the will of that power, which at each successive period has had most preponderance in the north. So long as Poland was the great ruling power, Courland was subservient to that republic. When Sweden, under Gustavus Adolphus and his immediate successors, had gained a superiority over Poland, Courland was over-run by the Swedes, and its sovereign led into captivity. The fortune of the house of Vasa having afterwards declined, and the ascendancy having come into the possession of Russia, Courland became almost a province of that power; its dukes were elected and deposed, its councils guided by the influence of the court of St Petersburgh, and its dependence on Poland was no longer any thing more than a mere empty name. As the influence of Russia in Poland began afterwards to be diminished, the duke of Courland proceeded to effect the emancipation of himself and his estate from their absolute dependance on that court. After a succession of vicissitudes, during the progress of which the sovereignty of the duchy was sometimes vested alternately in one or another of different contending competitors; sometimes was altogether without a regular head, while party strove against party within the state, and the desire of regulating its affairs embroiled with it or with each other several of the greater neighbouring powers, the rule of succession was at length established, that the appointment of the dukes should rest with the diet of Courland, but subject to the approbation of the king and republic of Poland. After the conquest and final division of Poland, its feudal dependance on that republic was no longer recognised, and the country was annexed to the empire of Russia. Since that period, (A. D. 1795,) the so much greater affairs which have agitated and engaged all the powers of Europe, and of which the consequence has been an entire change in many parts as to all the existing establishments and relations, though Courland may not have been without its share in the results to which those mighty operations have led, must yet necessarily cause that the interests and the fate of it, as of any other such petty state, can have little in them comparatively to occupy attention. It will remain for the future geographer and historian to collect, as they best may, the meagre details which concern this spot, from amidst the eventful records of the great transactions that had been passing around it, and to fix the limits within which, it may be, it will only be a matter of tradition or of history that it was once contained.

It is to be observed, that the troubles and commotions in which Courland has been so long involved, and by which it has been wasted and destroyed, have been, in a great measure, the consequence of the enormous privileges of its nobles. The internal history of the country is, indeed, little else than a continued series of disputes between them and its dukes; and its boasted liberty has been no other than an aristocratical licentiousness, free itself to commit all kinds of enormities, but holding the rest of the community in a state of the most galling oppression. Here, consequently, as in other countries similarly circumstanced, a declining state of agriculture has been the result of the state of degradation and wretchedness, which has been the unmerited lot of the peasantry. Commerce has languished, because the merchants have been despised; and literature has suffered through the neglect of men of learning. The nobles and gentry were the only landholders, and with this distinction they centered in themselves the whole powers and emoluments of government, and, indeed, enjoyed exclusively the common advantages which are the natural birthright of mankind, and are equally necessary to the happiness of the individual and of society. Such odious slavery is now, however, and has for a considerable period past, been fast losing ground; men are become much more enlightened than they once were; and the time is, perhaps, not far distant, when the citizen, the merchant, the manufacturer, and the peasant, will universally gain that esteem and consequence to which their usefulness and importance in society most justly entitle them.

The population of the duchy of Courland has been estimated to exceed a million and a half.

See Peuchet's *Diction. Univers. de la Geogr. commerçante*; Coxe's *Travels into Poland, Russia, Sweden, and Denmark*, vol. ii.; *Description de la Livonie, des duchés de Courlande, de Semigalle, &c. traduite de l'allemand*, Utrecht, 1705; Tooke's *View of the Russian empire*, vol. i.; and Mirabeau, *Hist. secrete de la Courlande*, Berlin, vol. i. (K)

COURSING. See HUNTING.

Court.

COURT, (*Curia,*) commonly signifies the king's palace, or mansion. But as the king is constitutionally considered as the fountain of justice, and it is extremely probable, if not certain, that, in very early times, our kings often heard and determined causes between party and party in person; the term *court* came to be applied more generally to those places where justice is judicially administered. These judicial establishments must, of course, be various, in regard to their nature and forms of proceeding, according to the different constitutions of government under which they exist. In this article we propose merely to give a short account of the several courts of law in England and Scotland, together with such historical remarks as appear necessary to elucidate the origin and nature of their jurisdiction.

By the ancient constitution of England, as regulated and established by Alfred, the courts of judicature were as numerous as the manors or townships in the kingdom; in order that injuries of every sort might be redressed in an easy and expeditious manner, by the suffrage of neighbours and friends. These small courts, however, communicated with others of more extensive jurisdiction; and these latter with others of still greater power; ascending gradually from the lowest to the supreme courts; which were respectively constituted to correct the errors of the inferior ones; and to determine such causes as, by reason of their importance and difficulty, appear to demand a more solemn discussion. These inferior courts, at least their names and forms, still continue in the legal constitution of England; but as the superior courts of record have in practice acquired a concurrent original jurisdiction with them, and as there is, besides, a power of removing actions thither from the inferior jurisdictions, these petty tribunals have gradually fallen into decay, and now almost into oblivion.

Before we proceed to consider the different species of courts, it may be proper to notice a distinction which runs through them all; viz. that some are courts *of record,* and others *not of record.* A court of record is one in which the acts and judicial proceedings are enrolled in parchment, for a perpetual memorial and testimony; which rolls are called the records of the court, and are of such high and supereminent authority, that their truth cannot be called in question, nor can any plea, or even proof, be admitted to the contrary. All courts of record are the king's courts; and no other court has authority to fine or imprison; so that the very erection of a new jurisdiction, with the power of fine and imprisonment, instantly constitutes a court of record. A court not of record, on the other hand, is the court of a private individual, whom the law does not entrust with any power over the fortune or liberty of his fellow subjects. Such are the courts-baron, and others to be afterwards mentioned, where the proceedings are not enrolled or recorded; but their existence, as well as the truth of the matters therein contained, may, if disputed, be tried and determined by a jury. These courts are not competent to matters cognizable by the common law, unless under the value of 40s. nor to any forcible injury, as they have no process to arrest the person of the defendant.

We shall now proceed to enumerate the several courts of civil, ecclesiastical, military, and criminal jurisdiction. In treating of the civil courts, we shall adopt the order observed by Blackstone; beginning with the lowest, and ascending to those of most extensive power and ultimate resort.

Court of Piepoudre.

1. The lowest and most expeditious court of justice in England is the *Court of Piepowders,* or *Picpoudre,* (*Curia pedis pulverisati,*) supposed to be so called from the dusty feet of the suitors; or, according to Sir Edward Coke, because justice is there done as speedily as dust can fall from the foot. But a more ingenious and satisfactory derivation of the term has been given, from *pied puldreaux,* a pedlar, in old French; and therefore signifying the court of such petty chapmen as usually resort to fairs and markets. It is a court of record, instituted for the purpose of administering justice for all injuries done in that fair or market where it is held. The judge is the steward of him who owns or has the toll of the market. This court has the cognizance of all matters that can possibly arise within the precincts of that fair or market; the plaintiff must make oath that the cause of action arose there; and the injury must be done, complained of, heard and determined, within the compass of one and the same day. From this court there lies a writ of error, in the nature of an appeal, to the courts at Westminster.

Court-baron.

2. The *Court-baron* is a court incident to every manor, and is held by the steward. Its nature is twofold. The one is a customary court, appertaining entirely to the copyholders, in which those matters are transacted which concern their tenures only: (See Copyhold.) The other is a court of common law; the court of the barons or freeholders, in which the steward is rather the registrar than the judge. Its most important business is to determine, by writ of right, all controversies concerning the right of lands within the manor. It has also jurisdiction in personal actions, of debt, trespass, and the like, where the debt or damages do not amount to 40s. The proceedings on a writ of right may be removed into the county court by a precept from the sheriff, called a *tolt, quia tollit atque eximit causam e curia baronum;* and the proceedings in all other actions may be removed into superior courts by the king's writs of *pone,* or *accedas ad curiam.* After judgment, a writ of *false judgment* lies to the courts at Westminster; this not being a court of record.

Hundred-court.

3. The *Hundred-court* is only a larger court-baron, and resembles it in all other respects. It seems to have been derived by Alfred from the institutions of the ancient Germans; mention being made of this kind of jurisdiction, as existing among that people, by Cæsar and Tacitus.

County Court.

4. The *County Court* is a court incident to the jurisdiction of the sheriff. It is not a court of record, but may hold pleas of debt or damages under the value of 40s. The county court may also hold plea of many real actions, and of all personal actions to any amount, by virtue of a special writ called a *justicies.* In this court, the freeholders of the county are the real judges, and the sheriff the ministerial officer.

These are the several common law courts of particular and local jurisdiction. Those of a more general nature, whose jurisdiction extends over the whole kingdom, are 1. The court of *Common Pleas,* or *Common Bench,* (see Common Pleas); 2. The court of *King's Bench,* (see King's Bench); 3. The court of *Exchequer,* and, 4. Of *Exchequer Chamber,* (see Exchequer); 5. The high court of *Chancery,* (see Chancery); 6. The courts of *Assize* and *Nisi Prius,* (see Assize); and 7. The *House of Peers,* which is the supreme court of judicature in the united kingdoms, having no original jurisdiction over causes, but only on appeals and writs of error, to rectify any injustice committed by the courts below.

Besides these courts of common law, there are others

Court.

which take cognizance of matters of an ecclesiastical, military, and maritime nature.

Anciently, there was no distinction between the lay and the ecclesiastical jurisdiction. The bishop of the diocese and the alderman, or, in his absence, the sheriff of the county, used to sit together in the county court, and take cognizance of all causes, ecclesiastical as well as civil. This plan, however, was inconsistent with the policy of the court of Rome, and with the maxims of the canon law, which aimed at making the ecclesiastical independent of the civil power. But this doctrine was not received in England till after the Norman conquest, when William I. in favour of the clergy, separated the ecclesiastical from the civil jurisdiction. The union of the two courts was afterwards restored by king Henry I. upon his accession, conformably to the ancient law of the kingdom; but this measure was early disapproved of by the Popish clergy, who, under the direction of that arrogant prelate Archbishop Anselm, in their synod at Westminster, 3 Hen. I. ordained, that no bishop should attend the discussion of temporal causes, which soon dissolved the recent union. When, upon the death of Henry, the usurper Stephen was brought in and supported by the clergy, one article of the oath which they imposed upon him was, that ecclesiastical persons and ecclesiastical causes should be subject only to the bishop's jurisdiction; and the two courts have ever since continued distinct.

Ecclesiastical courts.

Of the ecclesiastical courts, or courts *Christian*, as they are often called, 1. The *Archdeacon's* court is the lowest. In the archdeacon's absence, this court is held before a judge appointed by him, called his *official*. By the statute 24 Henry VIII. an appeal lies from thence to, 2. The *Consistory* court of the diocesan bishop, of which the bishop's chancellor, or his commissary, is the judge. From this court there lies an appeal by the same statute to, 3. The court of *Arches*, which is a court of appeal belonging to the archbishop of each province. In this court, the archbishop's principal official receives and determines appeals from the sentences of all inferior ecclesiastical courts within the province. From him there lies an appeal, by statute 25 Hen. VIII. c. 19, to the king in chancery. 4. The court of *Peculiars* is a branch of the court of arches, which has jurisdiction over all those parishes dispersed through the province of Canterbury, in the midst of other dioceses, which are exempt from the ordinary's jurisdiction, and subject to the metropolitan only. By the statute 25 Hen. VIII. c. 12, an appeal lies from this court to the king in chancery. 5. The *prerogative* court takes cognizance of all testamentary causes; the probate of wills belonging to the archbishop of the province, by way of special prerogative. The judge of the prerogative court is appointed by the archbishop, and an appeal lies from him, by the statute 25 Hen. VIII. c. 19, to the king in chancery. The great court of appeal, in all ecclesiastical causes, is 6. The court of *Delegates*, consisting of lords spiritual and temporal, judges of the courts at Westminster, and doctors of the civil law. (See Appeal.) 7. A *commission of review* is sometimes granted, in extraordinary cases, to revise the sentence of the court of delegates.

Military Court.

The only military court established by the laws of England is the court of *Chivalry*, which was formerly held before the high constable and earl marshal of England jointly; but since the extinction of the former office, in the reign of Henry VIII. it has usually, with respect to civil matters, been held before the earl marshal only. This court has cognizance of contracts and other matters touching deeds of arms and war, and was in great repute during the times of pure chivalry, but is now grown almost entirely out of use. An appeal lies from its sentences to the king in person.

Maritime Courts.

The maritime courts, having jurisdiction in injuries arising upon the seas, or in parts out of the reach of the common law, are the court of *Admiralty*, and its courts of appeal. The court of admiralty is held before the lord high admiral of England, or his deputy. It is usually held at Doctors' Commons in London, and its proceedings are according to the civil law. From the sentences of the admiralty judge, an appeal lies to the king in chancery.

Private Courts.

There are also a number of courts of private and special jurisdiction in England, some of which are now fallen almost entirely into disuse. Such are, 1. The *forest* courts, instituted for the government of the king's forests in different parts of the kingdom; and for the punishment of all injuries done to the king's deer or *venison*, to the *vert* or green swerd, and to the covert in which the deer are lodged. These are the courts of *Attachments*, of *Regard*, of *Sweinmote*, and of *Justice seat*. Since the revolution in 1688, the forest courts have fallen into total disuse. 2. Another species of private courts is that of *Commissioners of sewers*, appointed by a commission under the great seal, at the nomination of the lord chancellor, lord treasurer, and chief justices, pursuant to the statute 23 Hen. VIII. c. 5. This court is subject to the controul of the court of King's Bench. 3. The court of *Policies of insurance*, also appointed by commission; but on account of its limited jurisdiction, it has fallen into disuse; and no new commission has of late years issued. 4. The court of the *Marshalsea*, and the *Palace court*, courts of record instituted for the purpose of hearing and determining causes between the servants of the king's household, and others within the verges. These courts are held once a week in the borough of Southwark, and a writ of error lies from thence to the court of King's Bench. 5. The courts of the *Principality of Wales*, whence writs of error lie to the King's Bench. 6. The court of the *Duchy of Lancaster*, which does not appear to be a court of record. 7. The courts of the *Counties palatine of Chester, Lancaster, and Durham*, and the court of the *Cinque Ports*. 8. The *Stannary* courts in Devonshire and Cornwall, for administering justice among the tinners. No writ of error lies from them to the courts at Westminster, but an appeal from the steward to the under warden; from him to the lord warden; from thence to the privy council of the Prince of Wales, as Duke of Cornwall; and from thence to the king. 9. The several courts within the city of London, (such as the sheriff's court, and the court of hustings,) and other cities, boroughs, and incorporations throughout the kingdom, which are held by prescription, charter, or act of parliament. The most remarkable species of courts of this description, are the *Courts of Requests and of Conscience*, for the recovery of small debts, of which there was one erected in London, by an act of the common council, so early as the reign of Henry VIII. and confirmed by the statutes 1 Jac. I. and 3 Jac. I. c. 15, since explained and amended by 14 Geo. II. c. 10. According to the constitution of this court, two aldermen and four commoners sit twice a week to hear all causes of debt, not exceeding the value of 40s. which they examine in a summary way, by the oath of the parties, or other witnesses, and make such order therein as is consonant to equity and good conscience. Several other courts of conscience have been since erected, on the same plan, in other places. 10. The last species of private courts which we shall mention is the

Chancellor's court, in the universities of Oxford and Cambridge, which enjoy an exclusive jurisdiction in all civil suits, where a scholar or privileged person is one of the parties. The process in this court is much conformed to the civil law. These privileges were contained in their several charters, and confirmed by the statute 13 Eliz. c. 29. The jurisdiction is exercised at Oxford in the chancellor's court, by the vice-chancellor, his deputy, or assessor; from whom an appeal lies to delegates appointed by the congregation; from thence to other delegates of the house of convocation; and if all the three concur in the same sentence, it is final by the statutes of the university, according to the rule of the civil law. But if there be any discordance, an appeal lies, in the last resort, to delegates appointed by the crown under the great seal in chancery.

Courts of criminal jurisdiction in England.

The courts of criminal jurisdiction in England are, 1. The high court of *Parliament*; which proceeds in the trial of great and enormous offenders, whether lords or commoners, by the method of impeachment. 2. The court of the *Lord High Steward* of Great Britain; which is a court instituted for the trial of peers indicted for treason or felony, or for misprision of either: (See IMPEACHMENT, PARLIAMENT, PEERS, *House of*, and STEWARD, *High*.) 3. The court of *King's Bench;* which is the principal court of criminal jurisdiction in England: (See KING'S BENCH.) 4. The court of *Chivalry*; whose criminal as well as civil jurisdiction is fallen into entire disuse. 5. The high court of *Admiralty*: (See ADMIRALTY, *Court of*.) 6. The court of *Oyer* and *Terminer*, and general *Gaol Delivery*; which is held before the king's commissioners, among whom are usually two judges of the courts at Westminster, twice in every year, in every county of the kingdom; except the four northern counties, where it is held only once; and London and Middlesex, where it is held eight times: (See ASSIZE and CIRCUIT.) 7. The court of general *Quarter Sessions* of the peace, which is held before two or more justices of the peace, of whom one must be of the quorum, once in every quarter of a year, for the purpose of trying small felonies and trespasses: (See JUSTICE *of the Peace*.) 8. The *Sheriff's Tourn* is a court of record, held twice every year before the sheriff, in different parts of the county. Out of it arose, 9. The *Court-leet*, or *View of Frank-pledge;* which is also a court of record, held once a year within a particular hundred, lordship, or manor, before the steward of the leet. Its jurisdiction extends to the preservation of the peace, and the punishment of sundry minute offences against the public good. This court, however, has grown into disrepute; and its business has, for the most part, gradually devolved upon the Quarter Sessions. 10. The court of the *Coroner:* (See CORONER.) 11. The court of the *Clerk of the Market* is a court incident to every fair and market, to punish misdemeanors committed there, as the court of *Piepoudre* determines disputes relative to private property. The principal object of the jurisdiction of this court is to take cognizance of weights and measures.

There are some other private or special courts of more partial jurisdiction in criminal matters; such as, 1. The court of the *Lord Steward, Treasurer*, or *Comptroller* of the King's Household, which takes cognizance of felony, by any of the king's servants under the degree of a lord, in confederating, compassing, conspiring, and imagining the death of the king, or any of the privy-council, &c. The proceedings in this court are according to the course of the common law. 2. The court of the *Lord Steward of the King's Household*, erected by the statute 33d Henry VIII. c. 12. to hear and determine all treasons, misprisions of treason, murders, man-slaughters, bloodshed, &c. committed in any of the palaces or houses of the king, or in any house where he may happen to reside. One part of the punishment for shedding blood in the king's court is to cut off the hand of the offender; a ceremony which is minutely prescribed by the statute above mentioned. 3. The courts of the universities have jurisdiction in criminal offences under the degree of treason, felony, or *mayhem*. The trial of these crimes is committed, by a particular charter, to the court of the *Lord High Steward of the University*.

Courts of law in Scotland.

Since the abolition of the ancient heritable jurisdictions, the principal courts of law in Scotland are, 1. The *Court of the Baron*, whose jurisdiction was formerly pretty extensive, but is now, by the statute 20th Geo. II. c. 43. limited to the right of recovering from his vassals and tenants the feu-duties and rents of the land, and compelling them to perform the services to which they are bound, and to the right of determining civil questions, not exceeding the value of 40s. His criminal jurisdiction is confined to assaults, batteries, and smaller offences; but this jurisdiction is subject to such restrictions, that it is never exercised by the baron. 2. The *Borough Courts*. Bailies of boroughs take cognizance of matters of debt, services, and questions of possession between the inhabitants; and their criminal jurisdiction extends to petty riots, and to reckless (not intended) fire-raising. The court of the *Dean of Guild* has the cognizance of mercantile causes within boroughs, and the inspection of buildings, &c. 3. The courts of the *Justices of the Peace*. 4. The court of the *Sheriff*, or his Substitute: (See SHERIFF.) 5. The *Consistorial* or *Commissary* Court, which came in place of the Bishop's Court, and has an exclusive jurisdiction in ecclesiastical causes. 6. The court of the *High Admiral*, whose civil jurisdiction extends to all maritime causes; and in criminal cases, to all crimes committed upon the seas, on fresh water within flood-mark, and in all harbours or creeks: (See ADMIRALTY COURT.) 7. The Court of Exchequer, which takes cognizance of all matters concerning the revenue: (See EXCHEQUER.) 8. The Court of *Justiciary*, which is the supreme court of criminal jurisdiction in Scotland. It received its present form by the act 1672, c. 16. and consists of five of the lords of session, joined to the justice-general and justice-clerk, of whom the justice-general, and in his absence the justice-clerk, is president. The jurisdiction of the Court of Justiciary extends to all crimes committed throughout the kingdom. By the statute 20th Geo. II. c. 43, the lords of justiciary are directed to hold circuit courts regularly twice a year, in spring and in autumn; and, by the 23d Geo. III. c. 45, they are to continue in each town in the circuit at least three days, and in no case to leave any trial that has been commenced undecided: (See CIRCUIT and APPEAL.) 9. The *Court of Session* is the supreme court of civil jurisdiction in Scotland. It was instituted in the reign of King James V. in place of the daily council, and in imitation, it is said, of the parliament of Paris. The judges originally consisted of seven churchmen, and seven laymen, besides the president; and from the act 1579, c. 93, it appears that the president must have been chosen from among the churchmen. But by 1640, c. 26, churchmen were excluded from admission to the bench, and the distinction of spiritual and temporal judges was suppressed. Besides the fifteen ordinary judges, the king was anciently allowed to name three or four lords of his great council, who might sit and vote with them; but by the statute 10th Geo. I. the power of naming these extraordinary lords was renounced. The number of judges is therefore fifteen, of whom nine are a quorum. By the late statute 48th Geo. III. the constitution of the Court of Session received several essential alterations; the most important of which was its separation into two divisions or chambers; the first consisting of the lord president and seven of the other judges, the second of the lord-justice-clerk and six judges Several other material alterations have been adopted, of which we shall have occasion to speak in a future article.

Court-martial.

Court-martial is a court authorised by the mutiny act, for the trial of crimes committed by officers or soldiers in his Majesty's service. A court-martial must consist of at least thirteen judges, all commission officers, of whom the president must be a field-officer. The jurisdiction of this court extends only to points of military discipline; for in all other matters the military are amenable to the ordinary courts of law. No appeal lies against the sentence of a court-martial. It is reported to the king, from whom alone any change or alleviation is to be obtained. Courts-martial, in the sea service, are regulated by the statute 22d Geo. II. c. 33. See Blackstone's *Comment.* b. iii. ch. 3, 4, 5, and 6, and b. iv. ch. 19; Jacob's *Law Dict. v.* COURT; and Erskine's *Inst. of the Law of Scotland,* b. i. tit. 3. and 4. (z)

COURTRAY, CORTRYCK, *Corturiacum,* a town of France, in the department of the Lys, is situated upon the river Lys, which passes through the town. Courtray has been long celebrated for its manufactures, which are still carried on to a very considerable extent. The flax which grows in the neighbourhood has the character of being the strongest and the finest in Europe; and, from the great attention which has been paid to the processes of weaving and bleaching, the goods which are manufactured from it, are particularly celebrated, and find a ready sale. The manufacture of linen cloth, and table linens, is carried on to a great extent, and the latter are made with every possible variety of patterns. The lace which was made here, in imitation of that of Valenciennes, had a great demand both in France and England, and the manufacture of guingams and siamoises is briskly carried on. There are also in this town 22 bleachfields, 17 for linens, and five for thread, three houses for refining sugar, several soap-works, starch manufactories, breweries, and a manufactory for earthen ware, which is in great estimation. Population 13,372. (π)

COUTANCES, *Constantia,* a town of France in the department of La Manche, situated partly on a plain and partly upon a hill, between the rivers Soulle and Bulsare, about two leagues from the embouchure of the former into the ocean. The cathedral of Coutances is reckoned one of the finest Gothic buildings in Europe; but the town is principally celebrated for its trade and manufactures. Although this town is peculiarly fitted for carrying on the woollen manufacture on a very extensive scale, yet woollen goods are made to a very small extent. Druggets made of the wool of the country, and for the dress of the peasants, and a few other woollen goods, are the only articles of this kind which are made at present. The tanneries of this town, which are established in the Fauxbourg of Soulle, are numerous, and the skins are sent to Paris. Parchment is also manufactured at Coutances. The trade of the place consists chiefly of corn, butter, poultry, horses and cattle. Population 8507. (π)

COUTAREA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 194.

COUTOUBEA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 132.

COW. See DAIRY and MAMMALIA.

COWBRIDGE, the name of a market-town in South Wales, in the county of Glamorgan, situated in a fertile and delightful valley called the vale of Glamorgan. The town, which consists of one street about three quarters of a mile long, is tolerably well built, though badly paved, and has a town hall where the quarter sessions are annually held, a county bridewell, and a handsome parish church. One of the gates of the ancient stone walls, which was built in 1091 by Robert de St Quintin, still remains, and adorns the part of the town where it stands. The free school of Cowbridge was endowed by Sir Llewellyn, or Leolinus Jenkins, secretary of state in the reign of Charles II. "He was not," says Mr Malkin, "as has been erroneously stated, the founder; but, on the contrary, his benevolence was probably directed to this object by the recollection that he had derived the first elements of his great knowledge from this source. He may, however, be considered here also as a second founder, for it is to him that the young men on the foundation owe, in addition to a small annual stipend while at school, the probability of enjoying considerable advantages in Jesus College, Oxford, where there are two fellowships, two scholarships, and an exhibition, exclusively confined to students educated at this school. Its literary reputation has kept pace with its academical advantages, under a succession of able masters." There is likewise at Cowbridge a good school for reading, writing, and accounts. The Glamorganshire races are held on the heath, near Cowbridge, and at Cardiff, alternately. There are no manufactories in Cowbridge, but it appears to have been once of much greater extent, and to have had a monastery, which is said to have been converted into an university. The town is governed by two bailifs, 12 aldermen, and 12 common-council men. Population, in 1811, 850. Number of houses 166. See Malkin's *Scenery, Antiquities, and Biography of South Wales,* vol. i. p. 179, 180, and vol ii. p. 538; and Evan's *Cambrian Itinerary.* (w)

COWES. See WIGHT, *Isle of*

COWLEY, ABRAHAM, was the posthumous son of a grocer in London, and was born in 1618. His mother, though left a poor widow, found means to get him educated at Westminster-school, and he afterwards obtained a scholarship at Cambridge. In the window of his mother's apartment lay Spenser's Fairy Queen, in which he very early took delight to read, till, by feeling the charms of verse, he became, as he relates, irrecoverably a poet. He was indeed one of those poets who lisped in numbers. At ten years old, he wrote his tragic history of Pyramus and Thisbe, and at fifteen published a volume of poetry. At Cambridge, while yet a young student, he wrote the greater part of his Davideis, and published his comedy of Love's Riddle, with another in Latin, entitled the *Naufragium Joculare*; and, for the entertainment of the prince, as he passed through Cambridge on his way to York, drew the rough sketch of a piece called the Guardian, which was repeated by the scholars. In 1643, being now master of arts, he was ejected from the university by the parliamentary visitants, and taking refuge at Oxford, assailed his public enemies in a satire, entitled the Puritan and Papist.

From a sufferer he became a writer and an actor in the royal cause, followed the queen to Paris, became secretary to the Earl of St Albans, then Lord Jermyn, performed some confidential journies in the cause, and devoted his days, and frequently nights, in decyphering the correspondence of the king and queen. When his services were no longer necessary at Paris, he was, in 1656, sent back to England, according to Sprat, that, under pretence of privacy, he might take occasion of giving notice of the posture of things in this nation. This account, if true, places Cowley under the equivocal denomination of a spy in his native country. It was espionage, however, in a cause which he had embraced from principle, and there is no evidence that he practised it with arts of simulation degrading to his character. On his return, he was seized by the messengers of government in their search for another person, was put in prison, and not released till he found bail to the amount of £1000. His pursuits in England were sufficiently pacific; he published an edition of his poems, took the degree of a physician, and became a member of the newly instituted Philosophical Society. He seems not to have attempted the practice of physic; but having entered on botany as a preparatory study, he composed in Latin several books of botanical poetry.

At the dissolution of government, which followed the death of Oliver, he returned to France, where he resumed his former station, and staid till the restoration. Expecting from that event to be recompensed for his long fidelity and services, by the mastership of the Savoy, which had been promised to him successively by the two Charles's, he experienced great mortification from the neglect of the court. To increase his chagrin, his comedy entitled *Cutter of Coleman Street*,* which being falsely supposed a satire on the royal party, was severely received on the stage. In the dejection of mind occasioned by those events, he published his Complaint, in which he styles himself the melancholy Cowley. At length, through the interest of the Duke of Buckingham and the Earl of St Albans, he obtained a lease of a farm at Chertsey, held under the queen, by which his income was raised to about £300 per annum. A country retirement had been, from early youth, a real or imaginary object of his wishes, and had been a frequent theme of his prose as well as his verse. He retired first to Barn-elms, on the banks of the Thames; but this not agreeing with his health, he removed to Chertsey. Here he did not live long to experience either the enjoyments or discomforts of rustication. According to Sprat, the disorder which carried him off, was an affection of the lungs, contracted by staying too late in the fields among his labourers. But Mr Warton, on the authority of Spence, informs us, that Cowley paid a visit on foot, in company with the same Dr Sprat, to a gentleman in the neighbourhood of Chertsey, which they prolonged in free conviviality till midnight, and that missing their way on their return, they were obliged to pass the night under a hedge, which gave the poet a severe cold and fever, that terminated in death. He died on the 28th of July 1667, in the 49th year of his age, and was interred in Westminster Abbey, near the remains of Spenser and Chaucer.

Cowley is confessedly the best English poet in that class which has now prescriptively acquired the title of metaphysical. Their popularity in Europe may be traced to the fountain head of Italian poetry in Petrarch; but their characteristic perversities in bringing together remote analogies, and prolonging similitudes between material and mental objects, and substituting extravagant conceits for the genuine language of poetry and passion, are all found in equal perfection of absurdity among the ancestors of the Petrarchan school, namely, the troubadours or provincial poets, to the study of whom Petrarch was certainly addicted. This character of the troubadours, however, applies only to the later and more degenerate class of troubadours. In the earlier part of the middle ages, allegory was the favourite strain of European poetry, imbibed from the predilection of the learned for Boëthius. When the provincial bards found allegory inconvenient for their *sirvettes* or shorter effusions, they substituted protracted metaphor in the place of allegory, and supplied the fathers of Italian verse with those specimens of overlaboured figures which load and deform the tissue of Petrarch's and Marino's muse. In like manner, the metaphysical or conceitedly metaphorical school succeeded in England to the allegorical school of Sackville and Spenser. Donne, Drayton, Crawshaw, and Cowley, were the most ingenious poets of this dynasty, whose reputation suffered indeed in some degree from the rivalship of Denham and Waller, in a smoother, terser, more regular, and more majestic walk of poetry, but whose decline was only accomplished by the slowly rising reputation of Milton, and the more immediate popularity of Dryden. It is not our design to characterise more particularly any of the metaphysical school excepting Cowley. His defects, though strictly referable to that school, are intermingled with beauties of the most original unquestionable stamp. True it is, as the profligate Rochester said, his style not being of God, (we ought to substitute the word nature,) could not stand. But though no poet goes more extravagantly out of nature, there is none who occasionally lights on more naïve and natural expressions. Like a true metaphysical poet, he is for ever drawing upon his *learning* for the remote images which his fancy combines; but while he is racking his head for some far-fetched idea, he anon seems to start a thought from the very centre and core of his heart and feelings. As an instance of this, we may dip at hazard into his pages, and select his little poem on Friendship in Absence as an instance. After a string of forced and quaint ideas, in which he tells his friend,

> "By every wind that comes this way,
> Send me at least a sigh or two,
> Such and so many I'll repay,
> As shall themselves make winds to get to you;"

who would expect from such a prelude so beautiful and appropriate a thought as the concluding stanza.

> "And when no art affords me help or ease,
> I seek with verse my griefs t' appease;
> Just as a bird that flies about,
> And beats itself against the cage;
> Finding at last no passage out,
> It sits and sings, and so o'ercomes its rage."

The style of Cowley, keeping his matter distinct from his ideas, is easy, even to carelessness. Donne and Crashaw, among the poets of this school, were harsh and laborious in their structure of style; but Cowley rambled into what he called the Pindaric manner, which, though the remotest in the world from Pindar,

* The title of the play was without the article *the*, and is called "Cutter of Coleman Street," because a merry sharking fellow about town is the principal character in it.

Cowper.

was at least free from inversions; and if loose, negligent, and even slovenly, was at least free from the opposite extreme of stiffness,—a fault which often haunts correcter and terser poets.

Dr Hurd did considerable service to Cowley's memory, by selecting the best of his poems, or, more properly speaking, those of his pieces which are legible as entire poems. It was not, however, in the power of that or any other critic, to disengage all the genuine ideas of superlative poetical fancy, which sparkle like minute fragments of gold amidst the general dross of his composition. To have presented all his beauties, he must have culled broken sentences, which would be scarcely intelligible in a detached shape. After pages of dulness, we come to such striking thoughts, as when he apostrophises Hope,

> Brother of Fear more gaily clad,
> The merrier fool of the two, yet quite as mad.

He is never sublime, and neither his subjects nor his genius seem to have favoured the deep and genuine pathetic. But his fancy flutters on a gay and dazzling, though often fantastic wing. A gay, exhilarating, and elastic spirit of poetry supports him, without a single descent, throughout the whole of some of his pieces; as in his Ode to Wit, and his Chronicle, the latter of which productions Johnson characterizes with an eloquence which does equal honour to the poet and the critic: "The Chronicle is a composition unrivalled and alone; such gaiety of fancy, such varied similitude, such a succession of images, and such a dance of words, it is impossible to expect except from Cowley. His strength always appears in his agility—his volatility is not the flutter of a light, but the bound of an elastic mind. His levity never leaves his learning behind it —the moralist, the politician, and the critic, mingle their influence even in this airy frolic of genius. To such a performance Suckling could have brought the gaiety, but not the knowledge. Dryden could have supplied the knowledge, but not the gaiety." It is impossible to select such a paragraph from Johnson, without exclaiming, with reference to his criticisms, *O si sic omnia!* (*η*)

COWPER, William, an eminent English poet, was born at Berkhamstead in Hertfordshire in 1731. His father, the rector of that parish, was the son of Judge Cowper, of the Court of Common Pleas, and a nephew of the Lord Chancellor Cowper. The mother of the poet died when he was only six years of age, but he describes her as if his tender memory, and not his imagination, had supplied the poetical portrait. At an early age he was sent to Westminster school, a scene of bustle and contention peculiarly ill fitted for his sensibility. The recollection of his sufferings under his school-boy tyrants at that place, seems to have embittered his opinion of public education through life. At eighteen he was sent from Westminster to the house of a Mr Chapman, a London law-solicitor, who by his own account paid little or no attention to the profession. His next removal was to chambers in the Inner Temple; but still his aversion to dry study, probably occasioned by his constitutional melancholy, and his predilection for polite literature, prevented his progress and hopes in the legal profession. He was not, however, wholly idle, but wrote from time to time translations from Horace, occasional poems, and some prose papers, which appeared in the Connoisseur, and have been deservedly noticed for their ease and elegance of style. To these writings he did not give his name.

When turned of 30, having cherished a strong attachment for a lady of great accomplishments and beauty, (the object of his affections is said in common report to have been a sister of Lady Hesketh), he looked forward to a happy settlement for life, and was appointed to be the reading clerk of the private committees of the House of Lords; but on account of his great dread of public appearance, the situation was changed to the clerkship of the Journals of the same House. Even in this appointment, however, an unlucky dispute in Parliament required his standing a public examination; and though he had prepared himself for months by studying the Journals, he was so fearful of his memory failing, that he could not make the experiment. Under the terrors and regret attending this disappointment, the fine fabric of his mind was overthrown, and it was necessary to remove him to St Alban's, to be under the care of Dr Cotton, with whom he continued 19 months. Removing to Huntingdon, for the sake of being near his brother, a clergyman and fellow of Cambridge, he fell into intimacy with some inhabitants of that place, who certainly contributed to deepen the shade of that religious melancholy which had sprung up in his mind since his recovery. The younger Mr Unwin, the son of a clergyman of Huntingdon, made acquaintance with Cowper one day after church, and introduced him to his mother, Mrs Unwin, the future Mary of the poet, and to the elder Mr Unwin who was still alive. He was soon domesticated in the family of the Unwins, and his routine of life among these well-meaning enthusiasts is thus described: "We breakfast," says Cowper in one of his letters," commonly between eight and nine; till eleven we read either the scriptures, or the sermons of some faithful preacher of those holy mysteries. At eleven we attend divine service, which is performed here twice every day, and from twelve to three we separate and amuse ourselves as we please. During that interval I either read in my own apartment, or walk or ride, or work in the garden. We seldom sit an hour after dinner; but, if the weather permits, adjourn to the garden, where, with Mrs Unwin and her son, I have generally the pleasure of religious conversation till tea-time. If it rains, or is too windy for walking, we either converse within doors, or sing some hymns of Martin's collection, and, by the help of Mrs Unwin's harpsichord, make up a tolerable concert, in which our hearts, I hope, are the best and most musical performers. After tea we sally forth to walk in good earnest, (Mrs Unwin is a good walker,) and we have generally travelled above four miles before we see home again. When the days are short, we make the excursion in the former part of the day between church-time and dinner. At night we read and converse as before till supper, and commonly finish the evening either with hymns or a sermon, and last of all the family are called to prayers." On the death of the elder Mr Unwin, he removed with the family to Olney in Buckinghamshire. Here the society of Mr Newton, a person of the same principles with the Unwins, contributed to fix his mind, without variety or relief, on those awful subjects, which, however proper to be recalled to the careless and insensible, are most dangerous to a diseased mind like Cowper's, whose distemper was religious madness, and whose constant melancholy rose from an idea that he was the only soul in the universe who was to be excluded from the system of divine mercy.

In 1773 his tremendous malady returned, and lasted for nearly eight years. When his mind had broken through its long eclipse, he came before the world, for the first time, as an avowed author, at the age of 50. The reception of his first volume was not so popular as it deserved to be, considering the truth, originality, and pathos, of many of his sentiments and descriptions, probably owing to the puritanical tone of religious austerity, and the harshness of versification, which obscured its beauties. In the same year (1781) that his volume appeared, the accomplished Lady Austen came to Olney. Her vivacity and colloquial powers seem to have fascinated Cowper, and her goodness of heart to have gained his warmest friendship. At her instance he commenced the poem of the Task. Cowper had complained of the difficulty of finding a subject. Lady Austen told him that he could be in no want of a subject; you can write (said she) upon any thing, "write upon this sopha." Cowper adopted the subject, probably intending at first (as the introductory lines seem to shew) a mock heroic effusion; but led by that boundless power of association, by which he could link the most serious moral to trivial circumstances, he soon left the insignificant subject from which he had started, to expatiate over the whole field of moral sentiment and picturesque description. It is painful to think, that the jealousy of Mary Unwin compelled him to renounce the friendship of Lady Austen. The Task was finished in 1783, and he had scarcely finished it when he commenced translating Homer into blank verse, which was finished in 1791, and published by subscription. After this he accepted of a literary engagement from Johnson the bookseller, to make a version of Milton's Italian poetry, and write a commentary on his whole works. To this engagement he had, unfortunately, for the rest of his life but little serenity of mind to apply. His mental depression returned in 1792, and continued severely during the following year. As Mary Unwin had now become paralytic, Cowper's kinswoman, Lady Hesketh, undertook, with great kindness, the management of his household. In 1794, Mr Hayley, a friend in whom the poet had much delighted in the days when he possessed his faculties, came to visit him; but Cowper was now so sunk in melancholy torpor, that he expressed no joy at the sight of him; and when the news of his Majesty having settled a pension on the unhappy sufferer was announced, it gave him no visible pleasure. In 1795 he was removed from Olney, together with Mrs Unwin, to the house of his relation at Tuddenham, the Rev. Mr Johnson. Stopping on the journey at the village of Eaton near St Neot's, he walked with his young kinsman in the church-yard by moonlight, and talked of the poet Thomson with more composure than he had shewn for several months. Soon after he visited his cousin Mrs Bodham at Mattishall, when he saw in her house his own portrait by Abbot; he clasped his hands in an agony of grief, wishing that his present sensations could be what they were when that picture was painted.

Some dawnings of restoration shewed themselves in the summer of 1796, but disappeared again in the autumn. Mrs Unwin expired at the house of Mr Johnson at East Dereham in the December of that year. Cowper had seen her about half an hour before her expiration. In the dusk of the evening he accompanied Mr Johnson to survey the corpse; but after looking at it a few minutes, started away with an unfinished exclamation of grief, and either from fear to trust his lips with her name, or forgetting her from mental alienation, never afterwards spoke of her. In 1799, he resumed some power of exertion; he revised his Homer, made some translations, and composed his last and affecting original poem the Cast-away. The dismally despondent tone of that effusion shews that his melancholy was not abated by the last blaze of his intellectual faculties. In 1800 the dropsy, which had before appeared, shewed fatal symptoms of progress in his constitution, and he expired, after a rapid decline, on the 25th of April of the same year.

Cowper's publication of the Task, set him at least upon a par with any of his contemporaries in poetry, and perhaps superior to them all except Burns. Though he has not aspired to the first rate powers of poetic creation, in inventing incident and embodying characters, his pages are full of scenery and pictures of life and manners, dignified by the highest sentiments, and made interesting by the most tender touches of the social affections. If we miss in him the fairy enchantment of colouring which Thomson throws over the face of Nature in his descriptions, we have a plain fidelity to those minute features which are lost in the dazzling halo with which the former poet surrounds her. All is rapture and enthusiasm with Thomson. The result of Cowper's views is a calmly pleasing entertainment. Before Cowper, the English poets leant to the side of excessive embellishment in describing nature, and seemed to be shy of approaching rustic and ordinary life, except to burlesque it on the stilts of mock heroic, or to mask her homeliness either under Gothic antiquity of language, or the still more disgusting form of Arcadian pastoral. Cowper making an irresistible appeal to the interest which the human heart feels in whatever is human, took for subjects those humble and homely circumstances which create a pleasant association throughout the whole range of life and manners, with a gravity which gave them due importance, but with a familiarity of style also which suited their plainness. He reserved to himself, however, a chaste and sober dignity for higher subjects, in which there is a freer admixture of what is commonly called the language of poetry as distinguished from prose. This elevation, it is true, he but occasionally exercises; and we often find him in high regions of thought and sentiment, checking the sublimity of his flight by vulgar and familiar phraseology. In taking away the polish and colouring of poetical diction, he often leaves his style cadaverous and rugged. His sketches from humble nature are also frequently prolonged to tiresome minuteness, and lowered to objects with which poetry disdains alliance. His pictures of the Dung-bed, and the Gin Shop, and his Snoring Sick Nurse, are in this Dutch taste. A most unfortunate fault is, that the highest fire of his enthusiasm is so frequently mixed with the clouds of methodism and mysticism. The man was elevated and pure himself, but he assumes a character not his own, when he illustrates the depravity of the human race by the dressy propensity of a country girl wearing ornamental curls upon her head, for which she is "*indebted to some smart wig-weaver's hand.*" His contempt of what he calls the vanity of philosophy, also betrays an illiberality inexcusable even in a visionary recluse. His lighter pieces evince the finest conformation of social and domestic feelings which probably human beings ever possessed, and an exquisite talent for humour. His great translation has something of the bony and muscular greatness of the Grecian bard, but it is, in general, less like *Homer revived* than *Homer dug out of his grave.* (*n*)

COWPOX. See VACCINATION.

CRACKS. See VETERINARY MEDICINE.

CRACOW, CRACOVIA, *Carrodunum*, the ancient capital of Poland, is now a town of Austria, and the capital of West Gallicia. It is situated on an extensive plain upon the Vistula, near its confluence with the small river Rudowa. The city and the suburbs occupy a large tract of ground, but the houses are thinly scattered, and contain few inhabitants. Many of the streets are wide and handsome, and the great square, which contains several well-built houses, is very spacious; but, in consequence of the devastations which this city experienced from the Swedes at the beginning of the last century, and more recently from the Russians, it has the appearance of a magnificent capital in ruins. The number of uninhabited houses, the effects of cannon, grape, and musket shot on the walls, and the marks of ruined grandeur which everywhere appear, form a striking contrast with the splendour and beauty of the churches, which seem to have escaped the general ruin. The lofty brick walls with which Venceslaus surrounded the town, are defended by round and square towers of the most ridiculous shapes, and in the old style of fortification.

The principal public buildings are the palace or citadel, the university, the cathedral church, the palace of Casimir the Great, the observatory, the botanical garden, the library, and the hospital.

The palace or citadel, which was built by Ladislaus Jaghellon, and was the residence of the Polish king, is situated on the summit of a rock towards the southern part of the town near the Vistula, and is encircled with brick walls and old turrets. The greater part of it was destroyed by Charles XII. after the battle of Clissow. The few rooms which remain are very large and magnificent, but without furniture. The apartments are principally remarkable from their commanding an extensive view of the surrounding country. Two large barrows are particularly visible, and are supposed to be the sepulchres of Cracus, duke of Poland, and his daughter Venda. The fortress of Landskron, situated upon a rock, is also visible from the palace.

The university of Cracow was founded and endowed in 1342 by Casimir the Great, and was completed by Ladislaus Jaghellon. In 1778, the number of students was 600. The library presented nothing remarkable but a Turkish book found among the spoils of the battle of Chotzim, and presented by John Sobieski.

The cathedral, which is a fine building, contains an immense number of monuments erected to the memory of the Polish kings. A number of bones, which the vulgar believe to have belonged to giants, are suspended from the roof of the cathedral. The sepulchres of the kings of Poland are not remarkable for their magnificence. Some of them are without inscriptions, and in general the figure of the king is carved in marble, of very common workmanship. The mausoleum of John Sobieski, and the tomb of S. Stanislaus are particularly interesting. The cloister of the Franciscans is deserving of notice, and the wainscoating of the choir, which is incrusted with mother-of-pearl, is reckoned a piece of beautiful workmanship.

The palace of Casimir the Great, which is an old ruined structure, is in the neighbourhood of Cracow. "In the inner court," says Mr Coxe, "are the remains of a corridore, with pillars of the Doric order; and upon a side wall, I observed the white eagle of Poland carved in stone, and around it an inscription so much defaced that I could only make out ANN. DOM. M.CCCLXVII, which answers to the æra of Casimir, who died in 1370. Several marble columns were scattered around, which shewed the ancient magnificence of the building. The greater part of the fabric was evidently of later date than the reign of Casimir, and probably constructed by succeeding sovereigns upon the foundation of the ancient palace; perhaps by Stephen Bathori, from the inscription, STEPHANUS DEI GRATIA, which I traced; and also by Sigismund III. as I discovered his cypher, with the wheat sheaf, the arms of Gustavus Vasa, from whom he was lineally descended." In the garden is a barrow, which is said to be the tomb of Esther the Turk, who was Casimir's mistress. Casimir made this palace his principal residence.

The most interesting objects in the vicinity of Cracow, are the chateau and park of Pulawy, belonging to the Princess Czartoriska, and the salt mines of Wielitzka. The mines, which are only an hour and a half's ride from the town, are 743 feet deep, 1115 feet broad, and 6691 long. Visitors descend upon a number of seats made of girth attached to a large rope. At the end of 2½ minutes they reach the first stage, and the other three stages are descended by wooden ladders, or by steps cut out of the salt. The guides point out as the greatest curiosity several small chapels formed out of the rock salt. One of these is 30 feet long, and 25 broad, and the altar, the crucifix, the ornaments of the church, and the statues of several saints, are all formed out of the salt. Several of the excavations are of an enormous size, and have their flat roofs supported either with beams of timber or pillars of salt. Guettard informs us, that the uppermost stratum is sand, the second clay occasionally mixed with sand and gravel, and containing marine petrifactions, the third calcareous stone, and the rest salt. These mines have been wrought for more than 600 years, and before the partition of Poland, the profits which belonged to the king amounted to L.97,222 sterling annually. These mines are excavated in a ridge of hills at the northern extremity of the chain which joins the Carpathian mountains.

The population of Cracow in the 14th and 15th centuries was about 80,000. In 1778, when Mr Coxe visited it, the town contained 16,000 inhabitants, but it appears from very recent accounts, that its population is now 24,000. East Long. 19° 56′ 0″, North Lat. 50° 3′ 52″. See Coxe's *Travels in Poland*, &c. vol. i. p. 124—153, 5th edit. *Briese uber Schlesien, Krakau, Wieliczka, im Jahr* 1791 von J. F. Zollner, Berlin, 1792, 8vo; and *Mem. Acad. Par.* 1762. (π)

CRAMBE, a genus of plants of the class Tetradynamia, and order Siliculosa. See BOTANY, p. 260.

CRAMP. See MEDICINE.

CRANE, in mechanics, is a most useful machine for raising and lowering heavy bodies and large weights, and removing them from one situation to another within the sweep of its arm, which revolves upon a center. Cranes are most commonly applied on quays and wharfs for loading and unloading vessels, also to ware-houses, and in the erection of massy buildings, such as bridges and locks, and to many other purposes. The parts of a crane are denominated the *post* or upright, which is either immovable or turns upon pivots, according to the construction; the *gib*, an arm extending from the upper part of the post; and the *stay*, which is intended as a support to the gib, and is fixed in a diagonal direction from the gib to the bottom of the post. These, with the mechanical combination of wheels, pulleys, and levers to give the requisite power for raising the weights, complete the crane.

The most simple form of the crane, is that commonly used in stone and timber wharfs for unloading ves-

Crane.

Simple windlass crane.

sels, for which purpose it is well adapted, its power being very great. It has a frame, consisting of a strong beam, supported horizontally at 10 or 12 feet from the ground, on the top of several vertical posts, very firmly fixed in the ground, and securely braced with stays in every direction. At the extremity of the horizontal beam, the upper pivot of the gib is supported, the lower pivot resting on a post in the ground. This gib, or gibbet as it is called, from a resemblance to that machine, is a triangular frame of wood, one side being perpendicular, and supported on pivots at the top and bottom, so that the whole moves round on those as a vertical axis of motion. Near the upper end of the perpendicular post, a beam proceeds, forming the upper side of the triangle; while the third side is a brace, extended from the foot of the perpendicular to support the upper piece. From the extremity of the latter, the burden is suspended by a rope passing over a pulley; the other end of the rope is coiled round a vertical roller or capstan, turning on pivots, one supported by the horizontal beam first mentioned, and the other on a post in the ground. The capstan is turned round by means of long horizontal levers fixed to it, at which a great number of men may be employed to push them round; or in some cases they are drawn by horses. As the levers admit of a very great length, in proportion to the diameter of the windlass on which the rope coils, the power of this simple crane is very considerable, and may be doubled by a pair of blocks or pullies at the gib. When the burden is raised to a sufficient height, by turning the capstan, the gib, being swung round on its pivots, will convey the load into a cart or waggon placed on shore by the side of the crane.

Walking wheel crane.

Another kind of crane, which is equally common with the above, but used for lighter burdens, has the same gib, as indeed most cranes have; but the windlass, or barrel for the rope, is placed horizontal, and has a large vertical wheel fixed upon it. This is made of two wheels fixed on the axis at a distance apart, and united by boards, so as to form a large hollow cylinder or drum. Several men get into this wheel, and by constantly walking upwards on the inside, give it a tendency to revolve, and wind up the rope on the barrel. See Carriage, vol. v. p. 546, and Plate CXXXI. It is surprising, that so imperfect a machine as this should have been so universally adopted as it was, till within these few years. Even when the wheel is sixteen feet diameter, the labourers within cannot walk so far up it, from the perpendicular, as to have any effective leverage to turn it round. Though they are always exposed to extreme danger, and frequently meet with most shocking and fatal accidents, from slipping down in the wheel, or from being overpowered by the load; in this case, the wheel runs back with an accelerating velocity, and the people are thrown about within it in a most dreadful manner. From these defects of the common construction, skilful mechanicians have devised cranes that are not only more safe, but more powerful in their operation than the common walking crane. Some of the best of these will be described in the present article.

Mr Padmore's addition.

Mr Padmore, many years ago, contrived to prevent the dangers attending the use of the construction last described, by putting a ring of cogs all round the outside of the great wheel, and applying a trundle provided with winches to turn it. By this addition, the power was increased in the proportion of the number of cogs in the wheel to the number of staves in the trundle; and in order to prevent the wheel from running back by the force of the weight, should the man within it slip, or leave off walking, he added a ratchet wheel to the axis of the trundle. Two winches being fixed to the ends of the axle of the trundle, gave the people attending the crane the means of assisting the men in the wheel, when the load rendered it necessary. On the axle of the trundle, he likewise fixed a wooden wheel, provided with a brake or gripe, which could be forcibly pressed on the circumference of the wheel by a lever, to cause such a friction as would prevent the weight from descending too rapidly. By this means heavy goods may be either raised or let down at pleasure, without any danger of injuring the men who work the crane. This contrivance is ingenious, but the rapid motion of the circumference of the large walking wheels, in most cases, renders it inapplicable, unless a smaller cog wheel was fixed upon the same axis with the walking wheel.

Mr Ferguson's crane.

A crane, to be turned by winches, was contrived by the late Mr Ferguson, which has three trundles with different numbers of staves. Any one of these may be applied to the cogs of a horizontal wheel, mounted on an upright axle, round which is coiled the rope for drawing up the weight. This wheel has 96 cogs; the largest trundle 24 staves, the next 12, and the smallest 6; so that the largest revolves four times for one revolution of the wheel, the next eight, and the smallest 16. The winch is occasionally fixed on the axis of either of these trundles for turning it, and is applied to one or the other, according as the weight to be raised is smaller or larger. There is also a fourth trundle acting in the teeth of the great wheel; and on its axis is a brake and ratchet wheel. While the load is drawing up, the teeth of the ratchet wheel slip round below a catch which falls into them, and prevents the crane from turning backwards; thus detaining the weight in any part of its ascent, if the man who works at the winch should accidentally quit his hold, or wish to rest himself before the weight is completely raised. Making a due allowance for friction, a man may raise, by such a crane, from three to twelve times as much in weight as would balance his effort at the winch, viz. from 90 to 360lbs. taking the average labour. See Ferguson's *Lectures*, vol. ii.

Crane with cog wheels.

Many other constructions of wheel-work are in common use for cranes. When they are turned by a winch, it is proper to apply a fly wheel to the axis of it, both to equalize the efforts of the labourer who turns it, and in case he accidentally lets go the handle, to prevent the load from running down so quickly as to endanger any thing. It is convenient to have several different powers to a crane of this kind, to adapt it for the different burdens to be raised. This is best done by employing a train of several wheels, each turned by a pinion smaller than itself. Thus, suppose the barrel on which the rope or chain winds be 12 inches diameter, and has a cog wheel of 96 teeth fixed upon the end of it, this is turned by a pinion of 12 leaves; on the same axis with this is a wheel of 32 teeth, moved by a pinion of eight, situated on a third axis, which should carry the fly wheel. A winch of one foot radius can be applied to any of these three axes in the crane, and will give three different powers. Thus, if it is applied to the gudgeon of the barrel, it will double the power of the labourer, because the winch describes a circle which is twice as large as the barrel on which the chain winds. If the winch is fixed on the end of the axis which carries the pinion of 12, and wheel of 32, it will give the labourer a purchase of 16 times. And lastly, when the

Of three powers.

winch is applied to the pinion of eight, his efforts will be multiplied 64 times. This simple mechanism is rendered very complete, by fixing a fly wheel upon the axis of the pinion of eight, to prevent all danger of accidents; for which purpose it is more effective than a ratchet wheel, and requires no attention. The spindles of all the wheels are made capable of sliding endwise, for the purpose of disengaging the wheels from each other at pleasure, that when the wheels are not employed there may be no unnecessary friction in turning them round.

Mr White's inclined walking wheel.

Plate CCXV. Fig. 4.

To remedy the inconveniences and defects of the common walking-wheel crane, Mr James White, of Chevening in Kent, proposed the construction shewn in Fig. 4. which is described in the Transactions to the Society for the Encouragement of Arts. BB is an inclined axis or spindle, turning on pivots at c and b, which are supported in the different floors of the warehouse where the crane is erected: on this axis the rope of the crane is coiled, and, passing over a pulley at D, is conducted to the gib. The motion is given by people walking on an inclined wheel AA, which is strongly framed upon the axis, and revolves with it: it is inclined to the horizon about 20 degrees, and works in an opening in the floor $m\,m$. Now, it is plain that a man walking upon this wheel will, by his weight, give it a tendency to revolve, and the power will depend upon his distance from the centre of the wheel; but to increase his effort beyond his mere weight, he applies his hands to a rail F, extended across the wheel about breast high, and pushes the wheel round beneath his feet. By this combined action of his weight and muscular action, the inventor supposes a labourer will work to a greater effect than in any other manner. To render it quite safe from accidents, a brake is thus applied: the rail F is fixed at one end to an upright axis EG, so that it acts in the manner of a lever; G is a shorter lever fixed on the same axis, and connected by an iron rod H, with a gripe K, which embraces part of the circumference of the wheel, to prevent its turning unless the brake is first removed by pushing the rail F; g is a chord fastened to the extremity of the rail F, and, going over a pulley in the floor, has a weight suspended from it. This always gives the rail a tendency to draw the gripe close, and stop the wheel; and by the weight coming up to the pulley, it stops the rail from going too far, when pressed by a man walking on the wheel. The stationary end of the gripe is jointed to a stout upright beam, going from the floor to the ceiling; and to prevent the gripe falling down, and getting from its work, the intermediate part of it is suspended by cords from the ceiling. The safety of this crane is its greatest recommendation; for it is obvious that it cannot move but during the pleasure of the workman, and while he is actually pressing upon the rail F; and if he should slip down, or the crane rope break, the gripe stops the wheel the instant he ceases to press on the rail. Mr White's crane admits of an almost infinite variety of

Its powers.

different powers within its limits; and this variation is obtained, without the least alteration of any part of the machine; if, in unloading a vessel, there should be found goods of every weight, from a few hundreds to a ton and upwards, the man who does the work will be able so to adapt his strength to each, as to raise it in a space of time proportional to its weight, he walking always with the same velocity, as nature will teach him. It is a great disadvantage in some cranes, that the smallest weight must be as long in raising as the largest, unless the man turns or walks with a greater velocity, which tires him in still greater proportion. In some cranes, two or three different powers may be procured, to obtain which some pinion must be shifted, or a fresh handle applied and resorted to. In this crane, on the contrary, if the labourer finds his load so heavy, as to permit him to ascend the wheel without its turning, let him move only a step or two towards the circumference, and he will be fully equal to the task. Again, if the load be so light, as scarcely to resist the action of his feet, and thus oblige him to run through so much space, as to tire him beyond necessity, let him move laterally towards the centre, and he will soon feel the place where his strength will suffer the least fatigue by raising the load in question.

Crane gibs.

The gibbet of a crane is a very principal member, as we have before explained; but, in its common construction, it has some defects. The rope by which the burden is raised, passes exactly over the upper gudgeon of the vertical beam of the gib, and is confined between two small vertical rollers, in order that it may constantly lead fair with the pulley or sheave at the extremity of the gib. According to this construction, whenever the gib turns round its axis, the rope is bent so as to form an angle more or less acute, which causes a great increase of friction, and produces a continual effort to bring the arm of the gib into a parallel position to the inner part of the rope. These inconveniences may appear to be trifling, but, in actual practice, they are of no small importance; for they necessarily require a much greater exertion of power in raising goods, and the application of a constant force to keep the gib in the position that may be requisite; while the partial stress which is exerted on only a few strands of the rope, whilst bent into an acute angle, destroys it in a very short time.

Mr Bramah's gib.

A simple construction of the gib, invented by Mr Bramah, obviates all these defects, and at the same time possesses the very desirable property of permitting the gib of what is termed a wharf, or landing crane, to revolve wholly round its axis, and to land goods at any point of the circle described by the arm of the gib.

Plate CCXV. Fig. 1.

The simplest form of this contrivance is shewn in Fig. 1. in which AA represents the gib of a warehouse crane projecting from a wall. It has, as usual, a pulley at the extremity, from which the goods are suspended. The improvement consists in placing a pulley at S, to conduct the rope down through the axis of motion of the gib, the collars or rings, $a\,a$, on which it swings, being perforated for that purpose. The rope afterwards passes under a pulley b, which conducts it into the house to the crane or machine, by which the weight is elevated. The pulley b may be placed between the two collars $a\,a$, and then there will be no necessity for a perforation of the lower pivot of the gib. When the gib is required to describe a complete circle, instead of the two brackets at $a\,a$, fixed to the wall, a cast-iron pillar is used to support the gib, the collars $a\,a$ fitting upon it. The pillar is hollow, to admit the rope through it, and is firmly fixed in a vertical position, by a plate cast on the lower end of it, and screwed down upon the timber of the wharf. Beneath these beams there is another pulley, in place of b, to conduct the rope to the crane.

In many cranes, the whole machinery turns round together upon the pivots of the gib, which method answers extremely well, as it simplifies the machine, takes up less room, and admits of its reaching all round in a

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Crane.

Mr Gilpin's crane. Plate CCXV. Fig. 5.

circle. Plate CCXV. contains two of the best constructions on this principle. Fig. 5. is one invented by Mr Gilbert Gilpin, who presented it to the Society of Arts. It is particularly adapted for the use of a foundry, where heavy articles are required to be lifted in every part of the circle that the crane describes. The whole machine consists of a gib, the wheel-work being attached to it. The perpendicular, AB, is formed of two oak planks, only one of which can be seen in the Figure; they are eighteen inches wide, four thick, and sixteen feet long. These, at the top and bottom, are let into cast-iron mortise pieces CD, which retain the planks at ten inches asunder. E is the barrel for the chain, which has a spiral groove turned in its circumference, for the reception of the links of the chain: it turns in the space between the two uprights AB. The top mortise piece C, as shewn by the dotted lines, has in the middle a dovetailed mortise, into which the stock H for the gib is fixed, and three bolts shewn at *k* secure the planks H fast to the uprights. These planks are of the same dimensions as the uprights, and the space between them forms a groove or opening for the top block K to slide in. The block is made of cast-iron, and has two grooves, which slide upon the upper edge of the planks H, only one of which is seen in the Figure. The block K carries the pulley *m*, over which the chain passes. The diagonal stay M is formed in a similar manner, and of the same dimensions as the other parts of the gib: it is connected to the perpendicular, by being received into the lower mortise piece D. N is the handle or winch to work the crane; it has a small pinion O fixed on the same axis: this pinion works in the teeth of the wheel P, on the same axle as the chain barrel E. S is the running block and hook, by which the goods are raised. Fig. 6. is an edge view of the lower part of the perpendicular, shewing the handle N, the pinion O, the great wheel P, and the barrel E, placed betwixt the two uprights AB. The whole of this crane is moveable on the pivots of the gib, the lower one of which is supported on the groundsil R, and the other by a beam F, extended across the building in which it is placed, so that the gib has liberty of traversing all round, to take up a burden at any part. The block K also slides along the upper beam H of the gib, and can be fixed at any place, which admits of the block S being brought perpendicularly over any spot. This is of very great importance in an iron foundry, for lifting heavy castings, cannon, &c. out of the moulds. We have seen one of these, in which the sliding block K had a long toothed rack attached to it. This was worked by a pinion, the axis of which carried a pulley for the reception of an endless rope, hanging down in reach of the workmen, who could therefore, by means of it, turn the pinion, and move the rack with the block to the desired spot, so as to give the crane any range within its reach; and it would take up a weight as well at six feet from the centre as at ten, which rendered it a most useful implement in such a situation, where the crane is frequently used to lower down moulds upon one another in a perpendicular direction. Mr Gilpin's crane shews a very good mode of construction for the gib, scarcely any part of the timber being cut away, and the strength of the materials, so far from being diminished, is augmented by the cast-iron mortise pieces. The upper beam of the gib is brought much closer to the upper gudgeon, and the centre lines of the perpendicular and the diagonal stay crossing each other at the top of the lower mortise piece, places the whole strain as near as possible in a line with the gudgeons. The business of the perpendicular becomes in consequence little more than that of a mere prop, and consequently requires no greater strength of materials than the diagonal stay. The barrel E, for the chain, is, as before mentioned, formed with a spiral groove, for the reception of the lower halves of those links which stand upright, the intermediate links lying flat on the surface of the barrel, as is shewn on a cross section, Fig. 7. By this means the chain leads extremely fair, and will work with far less friction than ropes, or any other contrivance. The pulleys S and K are grooved in the same manner. Fig. 8. by way of contrast, shews the awkward manner in which the links of a similar chain arrange themselves on a common pulley, tending to rend open the links as much as to resist the strain. This method of reeving chains, and substituting them for ropes, has, within these few years, become very general, as well in cranes as in the engines for drawing coals out of mines. It was, we believe, first adopted by the ingenious Mr Smeaton, in a crane he erected at the custom-house, about thirty years ago.

Fig. 6.

Crane.

Chain barrel.

Plate CCXV. Fig. 7.

Fig. 8.

Mr Kier's moveable crane. Fig. 9.

Fig. 9. represents a crane mounted on four trucks, to be capable of removal from place to place. It is employed on Ramsgate pier, for lifting stones used in the building, and is extremely well adapted for such a situation, as it requires no fixture, and will take up a weight of 4 tons with four men, without any danger of upsetting, which is a sufficient power for such purposes. It was designed and executed by Mr Peter Kier, by order of the trustees for the management of the harbour at Ramsgate. Its base consists of a cast iron frame marked AB, 9 feet 7 inches square, and two tons weight, supported on four cast iron wheels *b*, *b*, one pair of which is fixed on a common axle, which moves round on a centre fixed to one side of the frame. This axle has an arm projecting across beneath the frame to the opposite side, where a rack, or segment of a wheel, is fixed on it, as shewn at *c*, engaging a pinion *r*, shewn before the rack, on the top of whose axis a winch is applied at *d*. Now by turning this pinion, it twists the wheels round upon their centre, to steer the crane when moving from place to place. A vertical cast iron shaft DF, weighing 23 cwt. is erected on the centre of the iron frame, and is supported by oak braces E, E, stepped into boxes cast out of the iron frame AB at its angles, so as to form a very strong perpendicular column, round which axis the whole crane traverses. The weight of the framing and wheelwork, is supported by a steel pivot or gudgeon on the top of the shaft at F, and is guided by a collar embracing the shaft at I. The framing of the gib, or moveable part of the crane, consists of a long beam GH, bearing the pulley G at the extremity, resting on the pivot of the upright pillar in the middle, and the other end supporting the frame for the wheelwork LMN. Into this beam are framed two uprights Q, Q, suspending the platform IK, on which the men who work the crane stand. It is braced by a diagonal stay IP, and a cross piece R to prevent its bending.

Bramah's hydrostatic crane.

Mr Bramah's ingenious hydrostatic principle of gaining a great power, is applicable in several ways to the raising of heavy weights, and has been frequently employed in powerful cranes. In these, the power is not obtained by wheelwork, pulleys, or any other of the ordinary mechanical powers, but on the principle of the experiment called the hydrostatic paradox, which has been known for ages; but the application of its powers to useful purposes is due to Mr Bramah.

The simplest form is, for a machine to raise a heavy

Bramah's hydrostatic crane.

weight to a small height. A metallic cylinder sufficiently strong, and bored truly cylindrical within, has a solid piston fitted into it, which is made perfectly water tight, by leather packing round its edge, or other means used in hydraulic engines. The bottom of the cylinder must be made sufficiently strong with the other parts of the surface, to resist the greatest strain which can ever be applied to it. In the bottom of the cylinder is inserted the end of a small tube, the aperture of which communicates with the inside of the cylinder, and introduces water or other fluids into it. The other end of the pipe communicates with a small forcing pump, by which the water can be injected into the cylinder beneath its piston. The pump has of course, valves to prevent the return of the water. Now suppose the diameter of the cylinder to be six inches, and the diameter of the piston of the small pump, or injector, only one quarter of an inch; the proportions between the two surfaces, or ends of the said pistons, will be as the squares of their diameters, which are as 1 to 24. Therefore the areas will be as 1 to 576; and supposing the intermediate space between them to be filled with water, or any other dense and incompressible fluid, any force applied to the small piston will operate on the other in the above proportion of 1 to 576. Suppose the small piston, or injector, to be forced down when in the act of forcing, or injecting with a weight of 20 cwt. which can easily be done by means of a long lever, the piston of the great cylinder would then be moved up with a force equal to 1 ton multiplied by 576. Thus is constructed a hydro-mechanical engine, whereby a weight amounting to 576 tons can be raised by a simple lever, in much less time through equal space than could be done by any apparatus constructed on other known principles of mechanics, because it has so little loss from friction; and it may be proper to observe, that the effect of all other mechanical combinations is counteracted by an accumulated complication of parts, which renders them incapable of being usefully extended beyond a certain degree; but in machines, acted upon or constructed on this principle, every difficulty of the kind is obviated, and their power is subject to no finite restraint. To prove this, it will be only necessary to remark, that the force of any machine acting upon this principle, can be increased *ad infinitum*, either by extending the proportion between the diameter of the injector and the great cylinder, or by applying greater power to the lever actuating the small pump.

Plate CCXV. Fig. 1.

Fig. 1. Plate CCXV. represents a crane constructed on the hydrostatic principle, that is, by the injection of water from a small pump into a large cylinder, which is fitted with a piston, having a rack attached to it for the purpose of turning a pinion upon the axis of a large drum wheel or barrel, round which the rope is coiled, and from thence passes to the gib. In the Figure, AA represents the gib made of iron, and supported upon two brackets *a*, *a*, projecting from the wall of the warehouse in which the crane is supposed to be erected. The rope passes over the pulley S, and down through holes in the brackets *a*, *a*, then turns under the pulley *b*, and comes to the lower side of the great drum wheel B. The pinion C is fixed on the same axis with this, and its gudgeons turn in small iron frames *d*, bolted down to the floor of the warehouse. The pinion *c* is actuated by the teeth of the rack D, and a small roller, whose pivot is shewn at *e*, presses against the back of the rack, to keep its teeth up to the pinion. The rack is attached to the piston D of the cylinder L, in which the power for working the crane is obtained. This piston passes through a tight collar of leather in the top of the cylinder at E, which does not admit of any leakage by the side of it, and therefore if any water is forced into the cylinder, it must protrude the piston from it. The cylinder is supported in a wooden frame FF, and has a small copper pipe *g g* proceeding from the lower end of it, communicating with a small forcing pump at *h*. This stands in an iron cistern H, which contains the water, and sustains the standard *ii* for the centre of the handle G, with which the pump is worked by one or two men. The upper extremity of the standard *ii*, guides the piston rod *k* of the pump, to confine it to a vertical motion. *l* is a weight for counterbalancing the handle G of the pump. From what we have said before, the operation of this machine is evident. The power of the cylinder D is, in proportion to its size, compared with the size of the pump; but as it acts only through short limits, the pinion and drum B are necessary to lift the weight a sufficient height. The operation of lowering goods by this crane is extremely simple, as it is only necessary to open a cock at *m*, which suffers the water to escape from the cylinder into the cistern H, and the weight descends, but under the most perfect command of the person who regulates the opening of the cock; for, by diminishing the aperture, he can increase the resistance at pleasure, or stop it altogether.

Another kind.

Plate CCXV. Fig. 2.

Fig. 2. is the section of a cylinder for a crane, which is only adapted to raise weights to a small height, but possesses a great power; O is the chain, which is conducted over pulleys to the gib; CC is the cylinder, having a lid screwed on the end, with a stuffing box *m* in the centre, which makes a close fitting round the rod *l l*; this, at the other end, has a piston *k* fixed on it, which accurately fills the cylinder, and has leather all round to make it water tight. The other extremity of the cylinder has an eye cast on it for the reception of a hook, by which the cylinder is made fast. The pipe from the injecting pump is marked *i*. This cylinder may be placed horizontally beneath the floor, or suspended vertically by the side of the wall, and forms a most excellent and convenient crane for lifts of not more than 6 or 8 feet, though it may occasionally be used for a much greater height. Thus the rod *l* terminates in a large eye, through which the chain O is conducted; and a peg or pin being put through one of the links, gives a hold on the chain to draw up the weight, which being raised till the piston *k* reaches the bottom of the cylinder, the chain is to be made fast by a pin put through the links, and stopped against any fixture; the piston rod drawn out, and a new part of the chain taken through the eye at the end of it, to take a second lift; and so on of a third if required.

Application of the hydrostatic crane

The greatest advantage of the hydrostatic principle, is, that its power can so easily be transmitted to any distance, and in any direction, by means of pipes, conducted along in situations where all other means of conveying the motion would be complicated and expensive in the extreme; thus, in an extensive range of warehouses for a dock or depot, an injecting pump may be kept in constant action by horses, a water-mill, or steam-engine, and may inject water into an air vessel, from which pipes are conducted to cranes in all parts of the works; and by simply opening a cock at any crane, the required load will be instantly raised by the elasticity of the confined air operating on the enlarged surface of the piston of the crane. The air vessel has of course a safety valve, to allow the escape of the water when the pressure becomes so great as to endanger the rupture of the vessels; for it is to be observed, that the power of this principle is irresistible when the

Crane.

pump is worked by a mill, and will burst any vessels without the appearance of strain on the moving parts of the pump.

With an air vessel. Plate CCXV. Fig. 2.

The construction of a pump and air vessel of this kind is explained in Fig. 2. A represents the piston of the pump moving in a tight collar of leather at *a*, and is worked from the beam of a steam-engine, or other convenient power; *b* the suction valve of the pump, and *e* the forcing valve; *d* a small copper pipe communicating from the pump to the air vessel BB, and conducting the water into it; *l i* is one of the pipes proceeding from the air vessel to one of the cranes, and may be of any length, according to the distance of the crane. Near the cylinder of the crane, which may be either like Fig. 1. or Fig. 2. the pipe is provided with a stop valve *e*, formed on the end of the screw *g*, by turning which the valve can be opened or shut to admit the confined water from the air vessel into the cylinder, and thus raise the weight required: *h* is a similar valve, for lowering the weight, by permitting the discharge of the water at the opening *t*; for it is plain, that by shutting the valve *e*, and opening the discharge valve *h*, the water will return from the large cylinder of the crane along the pipe *i*, and rush out at the aperture *t*, and by that means permit the descent of the weight. On the other hand by keeping the discharge valve *h* shut, and opening the other at *e*, the water will have free passage from the air vessel to the great cylinder, which has been before described. The air vessel in this crane being charged with a great pressure by the pump, becomes a common reservoir for the supply of any number of cranes; and by opening the valve *e*, the water enters the great cylinder, and takes the weight up at once without loss of time. A safety valve, such as that shewn in Fig. 3. must be placed in some convenient part of the pipe *d*, to prevent the air vessel from being burst by overstraining it.

Lowering apparatus by Mr Hardie.

The common method of lowering goods, in wheel-cranes, by a brake and wheel, even with the advantage of a counterweight, is liable to injurious accidents to the men, as well as the goods, when they consist of damageable articles, such as wine, spirits, glass, &c. and sometimes from the rapid motion of the crane, parts of it fly off with violence, killing or wounding the persons near it; at other times the brake-rope becomes entangled by turning off the pullies or otherwise, or the rope may slide out of the hand of the man who conducts it; in either of which cases, the goods descend with all the accelerated velocity of a falling body, receiving damage, and killing or hurting the men, horses, &c. which happen to be beneath them; but these evils are completely removed by a lowering cylinder invented by Mr Hardie, and explained in Figs. 10. and 11. AA is a cast iron cylinder, bored true within, and screwed down to the iron bottom BB; by the side of this cylinder a pipe C is cast, communicating with it at the top and bottom at *c d*; the pipe C has a cock D in the middle, shutting off, at pleasure, the communication between the top and bottom of the cylinder A A; the spindle of this cock passes through a stuffing-box at *a*, and has a rack or sector *b*, fitted on it, to confine the cock in any position by the claw *e*, which drops into the teeth of the sector, at the same time showing the extent of the apertures which is opened. The large cylinder AA, has a tight piston E, sliding up and down in it, and its rod F slides through a stuffing box G, packed with leather to prevent leakage; the connecting rod H is jointed to the piston rod, at bottom, and to the crank I at the upper end. This crank is formed on the axis of the chain barrel, or any other convenient spindle of the crane, so that the burden cannot descend without turning the crank, and giving the piston a reciprocating motion up and down in the cylinder.

Plate CCXV. Figs. 10, 11.

Operation. Plate CCXV. Figs. 10, 11.

To explain the operation of this cylinder, suppose the piston pushed down to the bottom, and the cock D opened, it must be filled with oil, water, or any other liquid not likely to freeze or change by the weather, and the lid of the cylinder screwed fast down. Now, if the cock is quite shut, the oil or other liquid confined between the bottom and top of the cylinder, and the piston, will prevent it from moving, consequently the crank I, and chain barrel, or other part of the crane connected with the crank, stand at rest, suspending the weight of the goods hanging from the crane; but if the cock is opened a very little, the oil passes slowly through its aperture, and allows the piston E to move up and down slowly, and compelling the crane to move so too, regulates the descent of the goods. Thus the cock, by being more or less opened, regulates the precise velocity of the crane, or descent of the goods to be lowered, whatever their weight may be. (J. F.)

Cast iron cranes.

Cranes have been generally constructed of timber, but cast and wrought iron have been lately introduced, and, we think, with advantage, as they are generally exposed to the variations of the weather, which must soon injure the mortises and joinings of a wooden crane; besides, cast iron offers all the advantages of a judicious combination of its parts in having the strength duly proportioned, and in adapting its formation to any situation or circumstances.

Plate CCXVI. Fig. 1.

Plate CCXVI. Fig. 1. is a small cast iron crane: the post is made to turn in a collar fixed level with the ground's surface, and the bottom part is fixed on a wall or an iron cylinder. The gib and stay are in one casting, and joined to the post by screw bolts. This crane will carry one ton weight with safety. Fig. 2. is a similar crane, of greater strength and power. The collar is here drawn to revolve on a number of balls to lessen friction, but we think this unnecessary. It has a double gib and stay, which screw on each side of the post, and admit the pulley between them. The thickness of the plates of the gib may be $1\frac{1}{4}$ inch each, and will carry three tons with safety at the extremity of the gib. Fig. 3. and 4. are side and front elevations of a crane; the post is immoveable, and is fixed on an iron frame with arms extending in the form of a cross; the extremities of which are bolted down by strong screws to large blocks of stone sufficiently heavy to more than counterpoise the weight to be raised by the crane. In the top of the post is fixed a wrought iron pivot, by which the weight is supported, and a strong cast iron cap bears on the pivot, and has attached to it two iron frames, one on each side, that receive the pressure from the stay, as well as support the pull of the gib, which is formed of two bars of wrought iron. The lateral pressure is borne by the bottom of the post, round which two friction rollers turn to facilitate its motion. The Figures will sufficiently shew the construction of its parts. This crane will carry five tons with safety. Fig. 5. is another crane nearly similar to the last in construction, but the gib and stay are of cast iron in one piece or frame, two of which are used, (one on each side of the post,) and are supported by the cross cap at top and friction rollers at bottom. Here the wheel work is supported between the frames, which extend sufficiently wide to-

Fig. 2. Figs. 3, 4. Fig. 5.

wards the post to leave space for the barrel, and are brought so nearly together at the extremity to admit only the pulley between them. Chains are generally used to cranes exposed to the weather; and it is a considerable improvement to the barrels on which they wind, to have a spiral groove or hollow to receive them, as it prevents snapping and jerks from the climbing of the chain. This crane, with the frames $1\frac{1}{2}$ inch thick, will lift five tons with safety.

Plate CCXVI. Fig. 6.

Fig. 6. is a crane suitable for an iron foundry, the top pivot being supported by the roof: it is here introduced to show one of the methods of moving the pulley block, so useful in many cases. The gib is formed by two iron plates, between which the pulley block slides, being supported by the top edges of the gibs; to the pulley block is attached a moveable rack into which a pinion works; on the same axis with the pinion is fixed a larger wheel, into which another pinion works to give power to slide the block when a considerable weight is appended. These are turned by pulling a chain which works into an angular groove of a wheel placed on the same axis with the latter pinion. The plan will show the other parts of the crane, which will raise a weight of ten tons with safety; the plates of the gibs being two inches thick.

Fig. 7.

Fig. 7. is a barrel fixed between two iron frames, and a wheel and pinion to increase the power of a man at the winch: this is called a crab, and is most useful as a portable machine where mechanical power is required.

For the drawings and descriptions of these cast iron cranes, the Editor has been indebted to Mr Jessop, junior.

Plate CCXVII. Figs. 1, 2.

Figs. 1. and 2. are a side and back view of a pit crane erected in Messrs Sargent and Rutty's wharf, on the Grand Junction Canal at Paddington. It is composed of a cast iron frame shaft, with an oak gib and brace. It has three different powers, and each power is a double purchase. The height of the shaft is 20 feet, of which 11 feet is below the surface of the ground; it rests on a gudgeon about 6 inches diameter, and turns in a brass pot. At the surface of the ground two plates are fixed to the shaft about $4\frac{1}{2}$ inches asunder, between which are five rollers; when the crane is turned, these rollers move round the inside of a cast iron ring, which is fixed to timbers secured on the top of the wall of the pit; the disposition of these rollers will be seen in Fig. 3. The ends of the gib and brace are received into sockets cast in the shaft, and secured there by wrought iron straps. The gib is about 21 feet long, 12 inches by $10\frac{1}{2}$ at the shaft, and 16 inches by 12 at the outer end; the brace 10 inches square. The frame which composes the shaft is three inches in thickness; 1 foot 4 inches in breadth at the surface of the ground, and diminishes to 6 inches in breadth at the top, and to about seven inches at the bottom.

Fig. 3.

	Ft.	In.	
Diameter of the winch is	3	0.	
Ditto pinion *a*	0	$5\frac{1}{4}$.	—10 leaves.
Ditto wheel *b*, in which the pinion *a* works	3	$4\frac{1}{4}$.	—84 teeth.
Ditto pinion *c*	0	$7\frac{3}{4}$.	—15 leaves.
Ditto wheel *d*, in which the pinion *c* works	3	$1\frac{3}{4}$.	—80 teeth.
Ditto pinion *e*	1	$3\frac{3}{4}$.	—32 leaves.
Ditto wheel *f*, in which the pinion *e* works	2	$5\frac{1}{4}$.	—62 teeth.
Ditto pinion *g* (common to all the three powers)	0	$5\frac{3}{4}$.	—11 leaves.
Ditto wheel *h*, in which the pinion *g* works	4	$0\frac{1}{4}$.	—100 teeth
Ditto chain barrel *i*	1	4	
Ditto friction rollers for chain	0	9	

The diameters of the wheels and pinions are taken at the pitch line.

This crane was made by Messrs Lloyd and Ostell, London, and is warranted by them to carry eight tons with safety. It has occasionally been loaded with ten tons without appearing in the least strained. It cost, (1813,) including brickwork, timber, and fixing, L.350.

Plate CCXVII. Fig. 4—8.

The remaining Figures of Plate CCXVII. represent the double crane now in use (1813) for constructing the breakwater for protecting the entrance to Aberdeen harbour.

Fig. 4. represents a transverse view of the crane, working gear, and rollers for moving the crane forwards.

Fig. 5. is a longitudinal view of the crane and part of the breakwater, with one gib laying a stone on the building, and another lifting a stone from the waggon, which, with the railway, comes under the crane.

Fig. 6. exhibits a plan of the crane, with waggons and railways, as they are laid on when the work advances.

Fig. 7. shews an enlarged side view of the sliding carriage at *m* and *n*, Fig. 5, for laying the stones either close to the shaft, or as far out as the gib will reach. It is worked by a sheave and rope passing over the point of the gib, and down by the side of the spindle.

Fig. 8. is a plan of the sliding carriage and the sheave, over which the principal working chain or rope passes, and is attached to the working gear, which is placed in the middle to save room.

For the drawings and description of this crane, the Editor is indebted to Mr Gibbs, who superintends the improvements of the harbour at Aberdeen.

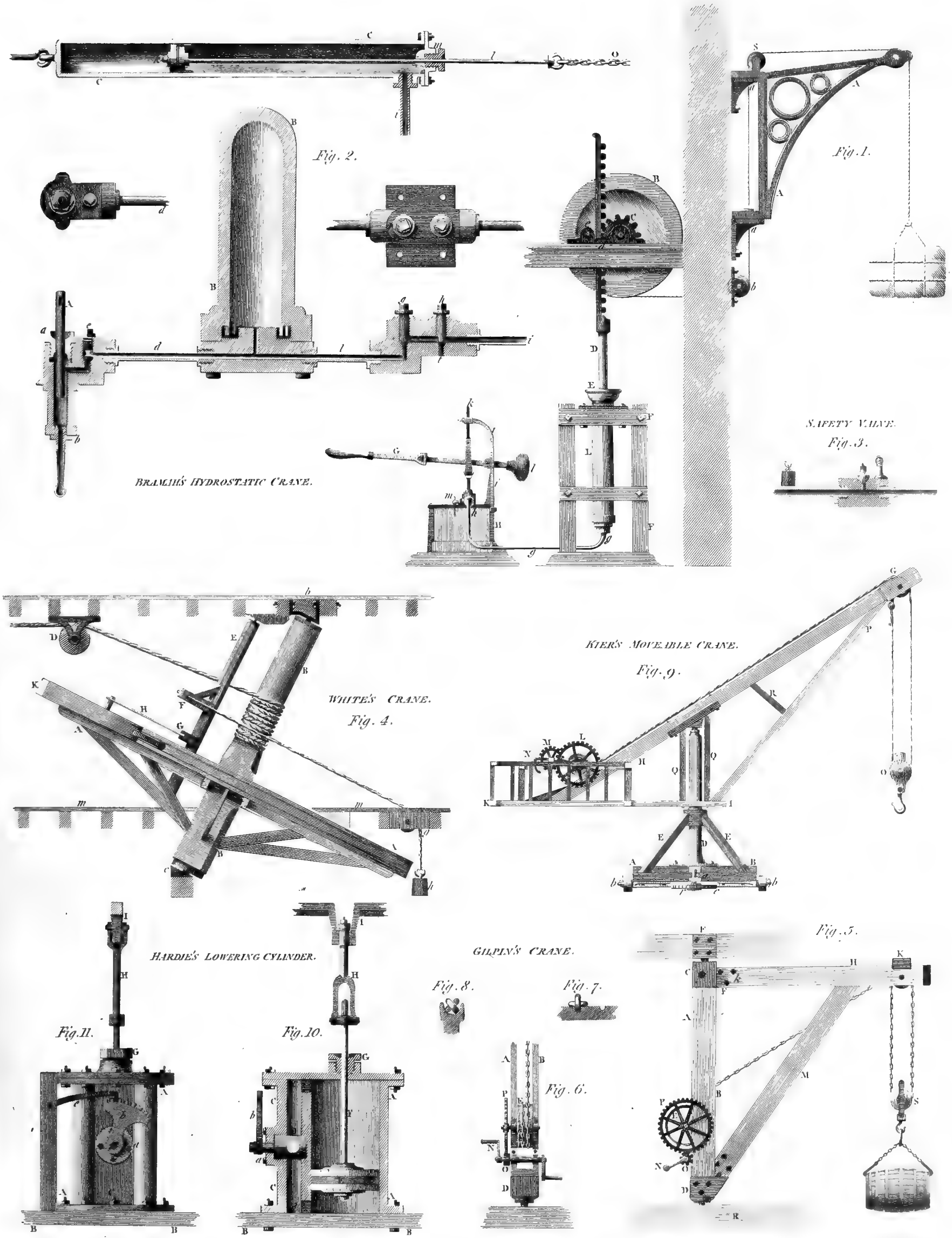
The cranes used for building the locks, &c. on the Caledonian canal, have a shaft about 40 feet high and one foot square; they turn upon a gudgeon at the bottom. At the top is a similar gudgeon, and a plate with four arms, and a hole in the centre is dropped upon it; to each of these arms is fixed a guy rope, which is carried to such a distance from the shaft, that when the crane turns round, the gib may keep clear of it. The lower end is thus connected with a pair of pulley blocks previously fastened to a pile driven in the ground for that purpose, and then drawn tight and secured. The gib is 26 feet long and 10 inches square, fixed a little higher than the middle of the shaft, supported from below by a brace, and suspended from above by a wrought iron bolt one inch square. It is worked by a common wheel and pinion.

It is advisable that the axis of the winch should be three feet from the surface of the ground, this being the height at which a man can most conveniently work it; its radius should be 1 foot 6 inches, which is as large as an ordinary man can conveniently turn, and by making it less, power is lost.

CRANICHIS, a genus of plants of the class Gynandria, and order Monandria. See Botany, p. 314.

CRANIOGNOMY. See the following articles.

CRANIOLOGY, (from κρανιον, *the skull*, and λογος, *a discourse*,) is a science teaching us to investigate the form, structure, and uses of the skulls in various animals, by which we learn their specific differences, and



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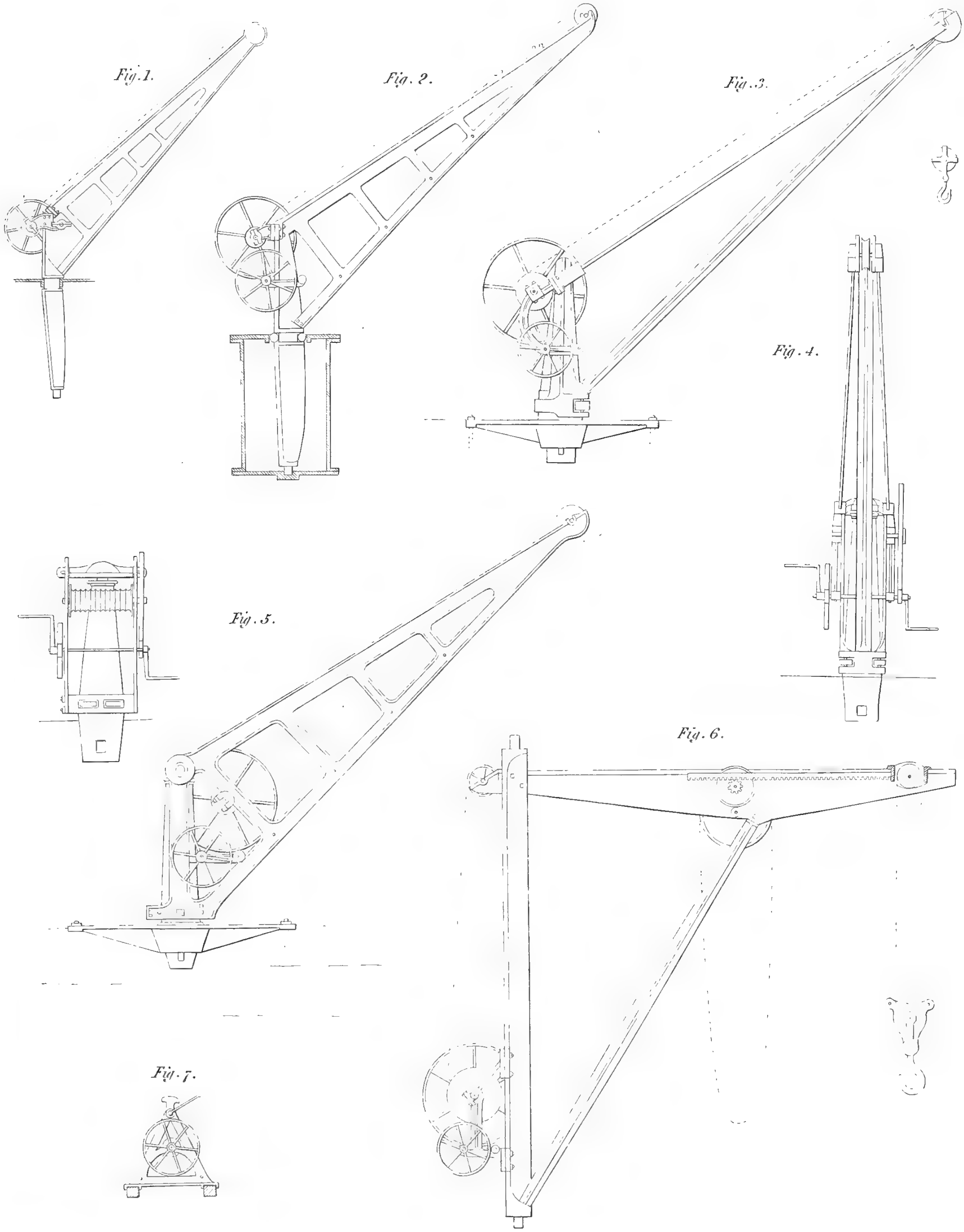
CRANES.

PLATE CCXVI.

CAST IRON CRANES.



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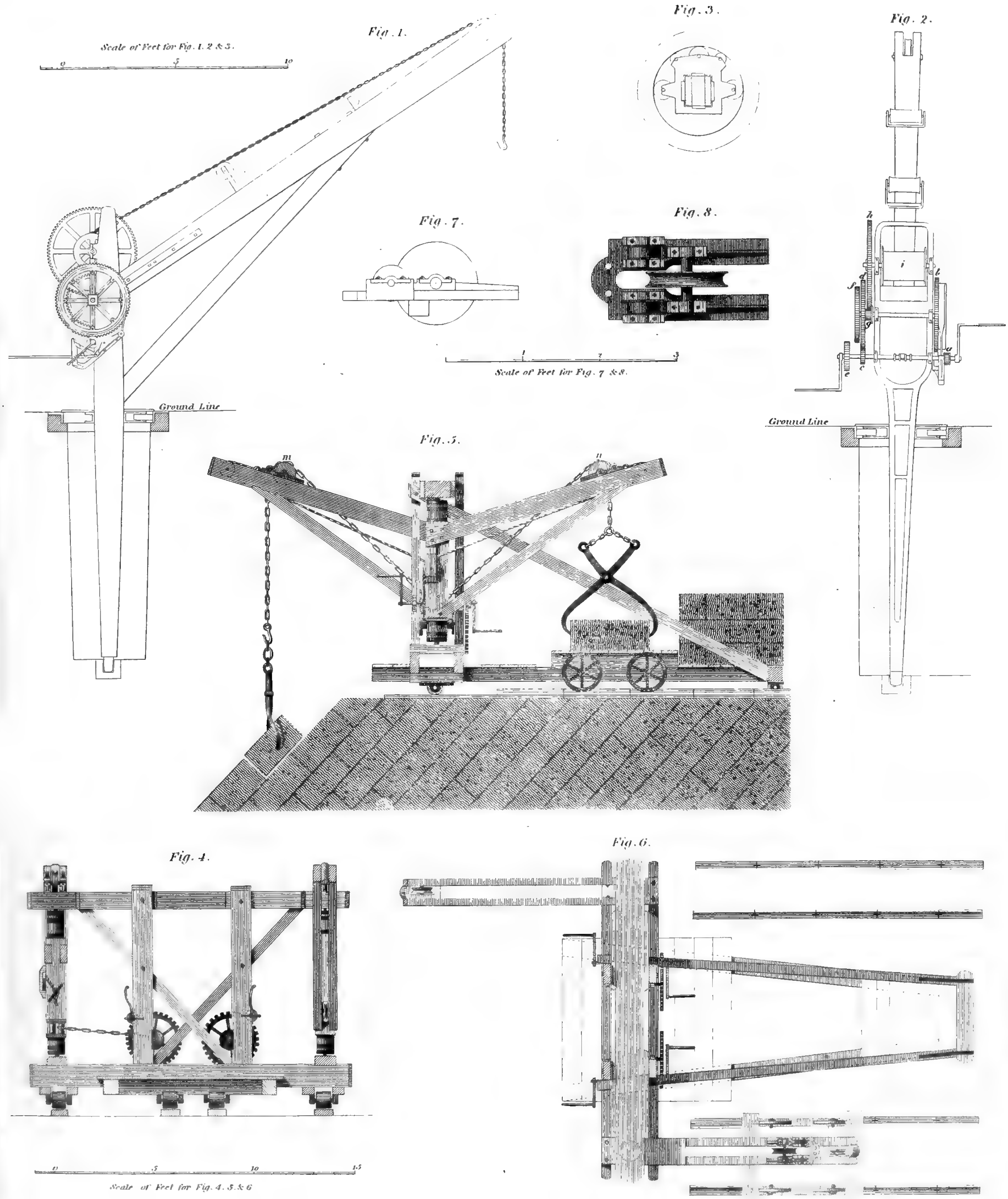
Scale of Feet.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Engd. by J. Moffat Edinr.



Drawn for the Edin^r. Encyclopaedia by M^r Gibb, Fig. 1. 2 & 3 by W. A. Provis

by J. Moffat Edin^r.

intellectual powers. See CRANIOMETRY, CRANIOSCOPY, and CRANIUM.

CRANIOMETRY, (from κρανιον, *the skull,* and μετρέω, *to measure,*) the art of measuring the skulls of animals, so as to discover their specific differences. It is of late only that this subject, which opens an important and most interesting field of investigation, has been examined with that attention which it deserves. The first attempt at any general remarks on the subject is contained in a paper entitled, "*Sur la difference du grand trou occipital dans l'homme et les autres animaux,*" by Daubenton, in the Memoirs of the French Academy of Sciences, for 1764. In this paper he endeavours to point out the differences existing between man and other animals, without any definition of the characters separating the races of mankind from one another; and nothing farther was done until the time of Camper, who, in 1791, attempted a more systematic arrangement of the national forms of the cranium; but unfortunately he did not possess a sufficient collection of skulls for this purpose. The differences he has pointed out regarding the degrees of prominence of the jaws, therefore, afford very insufficient criteria for determining the numerous points of distinction which characterise the *crania* of different nations.

It is very obvious, that a very close connection exists between the bones of the skull, and the features, or external parts of the face which they support; therefore a careful examination of the crania of the different species, will throw considerable light on the subject of varieties of the human race; for when freed of their soft parts, which are inconstant and less regular in their formation, they exhibit the firm and solid foundation of the head, they can be conveniently handled and examined, considered in various points of view, and compared with one another. Such a comparison shews us that the different races are no less distinguished by form of head, than by colour and features. Hence anatomists and naturalists have attempted to lay down some scale of dimensions to which the various forms of the skull might be referred, and by means of which they might be reduced into certain classes: how far they have succeeded, we shall endeavour to point out. Of these, the *Facial Line* or *Angle* of Camper first claims our attention.

FACIAL LINE OF CAMPER.

Facial line of Camper.

The cranium being placed laterad, two imaginary lines are drawn on its surface to meet each other at a particular point. The one proceeds horizontally through the meatus auditorius externus and the floor of the nostrils; the other from the most prominent portion of the forehead above the nose, to the front of the alveolar margin of the upper jaw-bone. The angle formed by the junction of these two lines is termed *Camper's facial angle,* which this illustrious anatomist conceived would point out the specific differences in the crania of men and other animals. By this measurement,

The angle of the European forms an angle of . .	80°
of the negro, ...	70
of the orang-outang, ...	58
of some monkeys, ...	42
of some mammalia, only	20

The boundaries of the facial line in the genus HOMO, are 70° and 80°; a smaller angle than the former constitutes an approach to the monkey. It may, however, be extended far beyond the latter, and still have a pleasing, nay fine effect. Thus in the Grecian statues we find the angle 100°; when beyond this the face appears monstrous; when below 70°, it is that of a brute.

This criterion of Camper's, is subject to some very essential objections. It is sufficiently obvious, that this line is only applicable to such varieties of the human race, as differ from each other in the various degrees of prominence of the jaws; and that it will not at all exhibit the characters of those which vary in the opposite way, viz. the greater or less breadth of the face and cranium. For it frequently happens, that crania of the most distinct nations, which differ *toto cœlo* from each other on the whole, have the same facial angle; and on the contrary, that skulls of the same nation, which agree in general character, differ very much in the direction of this line. Thus in the *Decades of Blumenbach,* we have represented the crania of a Negro and of a Pole, in whom the facial angle is exactly the same; and yet the general characters of the two skulls are widely different. In the former, the skull is narrow and almost keel-shaped; in the latter, broad and square. In the same work, two negroes skulls of very different facial angles, when viewed in front, most incontestibly betray their Ethiopic origin, by the same characters of a narrow and compressed cranium, and arched forehead. Camper himself, too, has employed his two lines, in the plates subjoined to his work, in so arbitrary and inconstant a manner, changing frequently the point of contact, on which their whole utility must depend, that he clearly appears to be hesitating and uncertain in their employment. This is not all; did Camper foresee that this line might change its position while the form of the head continued the same? "In the young skeleton," (says the celebrated anatomist Dr Barclay, in his *Anatomical Nomenclature,* page 150.) "where the bony meatus is entirely wanting, and where the line must consequently be drawn from the middle of the ring to which the membrana tympani is attached, will its direction be found the same, with regard to the face, as in the adult? Certainly not. The membrana tympani, or bottom of the external meatus, is more forward, inward, and downward, than the orifice where it is joined to the concha; and therefore the direction of this line, with regard to the head, must vary with the changes and relative situation of the meatus; a situation which is known to be different in different animals. In the cat, for instance, it enters horizontally; is more basilad than the zygomatic arch; and its basilar margin is more basilar than the base itself, or advances farther in the basilar direction. In the babyroussa, the meatus is long; runs from the tympanum in the coronal, lateral, and inial directions; or rises upwards, outwards, and backwards, supposing the erect posture of the animal, and the base of the head, to be at right angles to the vertebral column. In this animal, the external orifice of the meatus is more coronal than the zygoma, or more towards the crown of the head. If in these two instances, therefore, we were, in the manner of Camper, to draw the horizontal line from the middle of the orifice of the meatus, we should draw it from different points of the head, or from points that do not correspond in relative situation. The other point to which it is drawn is likewise variable with respect to position. In man and quadrupeds it is found near the maxillary curve. In birds it is often at one extremity of the maxilla, sometimes in the middle. In cetaceous animals, the spirucula, or breathing holes, run in a direction obliquely from the base towards the corona, and terminate in the face near the glabellar part of the cranium." The angle would, in such cases, be larger than

Craniometry.

human, approaching nearer to the Grecian divinities. To obviate this in some degree, Dr Barclay, and at the same time Cuvier, proposed two lines, which we shall call

Dr Barclay's Basi-facial Lines.

Dr Barclay's basi-facial lines.

The first, or *superior basi-facial angle*, is formed by drawing a line along the basilar surface of the palatine process of the superior maxillary bone, to meet the facial line; where this line is interrupted by the alveolar process, a line may be drawn from the dermal side, on the supposed continuation of the palatine plane. When the palatine plate is concave or convex, the line is supposed to be drawn on a plane that passes through its inial and antinial extremities. To measure this angle, an instrument, termed a *Gonio-craniometer*, has been invented by Dr Leach, Plate CCXVIII. Fig. 7, of which an explanation is given at the end of this article.

The second, or *inferior basi-facial angle*, is formed by drawing a line along the base of the lower jaw, until it meets the facial line. If the basilar side be either concave or convex, it is supposed to be drawn on a plane that proceeds from the angles to the basilar or lower side of the curvature. There is still another method of measuring, or rather viewing, the skull, which is termed

The Norma Verticalis of Blumenbach.

The Norma verticalis of Blumenbach.

Blumenbach states, that in the examination and classification of his immense collection of the crania of different nations, he finds it every day more and more difficult, amidst such numerous differences in the proportion and direction of various parts, all of which contribute more or less to national character, to reduce these to the measurements or angles of any single scale. Since, however, in distinguishing the characters of different crania, such a view will gain the preference over all others, as offers at one glance the most numerous and important points, and such as contribute especially to the comparison of national characteristics; he has found, from experience, that to be the best adapted to this purpose, which is obtained by placing the different crania, (including the lower jaws, if possible) with the zygomas, in the same perpendicular line, on a table in a row, and contemplating them from behind. When crania are thus arranged, those circumstances which contribute most to the formation of the national character, the direction of the jaws and cheek-bones, the proportional breadth or narrowness of the head, the arched or flattened form of the glabella, are all distinctly seen at one glance. This method of considering the cranium, is called by Blumenbach *Norma verticalis*. It is shewn in Plate CCXVIII. Figs. 3, 4, 5. Fig. 3. the skull of a negress from the coast of Guinea; Fig. 4, of a Georgian female, distinguished by the symmetry and beauty of all its parts. It is in the collection of Professor Blumenbach, from whose work the annexed outline is taken. The form of this head is of such distinguished elegance, that it attracts the attention of all who visit the collection in which it is contained. It corresponds exactly with the marble statue of a nymph in the collection of the late Mr Townley, of which Blumenbach possesses a plaster cast. It is rendered doubly interesting, as it tends to confirm the testimony of the numerous travellers who have unanimously concurred in extolling the beauty of the inhabitants of Georgia and the adjoining country.

Plate CCXVIII. Fig. 3, 4, 5.

Fig. 5. represents the cranium of a Tungoose, from the north-east of Asia. The margin of the orbits and zygoma are elegantly contrasted in the Georgian; and the jaws are hidden by the beautiful expansion of the glabella. In the Negro, the maxillary bones, and indeed the whole face, are compressed laterally, and project in front. In the Tungoose, on the contrary, the ossa malæ, ossa nasi, and glabella, are situated on nearly the same horizontal level, and are enormously expanded on each side.

Craniometry, Cranioscopy.

Whilst we are on the subject of the *Norma verticalis*, it may be proper to mention an instrument invented by Dr Barclay, for measuring the various diameters of the cranium, Plate CCXVIII. Fig. 6. By a combination of all these characters, viz. *basi-facial angles, norma verticalis*, and the different *diameters*, we can, with unerring certainty, discover the nation to which the skull belongs.

For a description of the *occipital angle*, see the article Cranium.

Explanation of Plate CCXVIII.

Plate CCXVIII. Fig. 1—6.

Fig. 1, Exhibits the facial angle of Camper, or an outline of the cranium of a Negro, whose angle is 70°.

Fig. 2, Shows the inferior basi-facial line of Dr Barclay on the skull of the Babarossa *Vulgaris*, (Sus *Babarossa*, Lin.)

Figs. 3, 4, 5, are copied from the Decades of Blumenbach.

Fig. 3, Skull of a Negress from the coast of Guinea.

Fig. 4, Skull of a Georgian female.

Fig. 5, Skull of a Tungoose.

Fig. 6.

Fig. 6, represents the craniometer invented by Dr Barclay for measuring the diameter of the skull. The instrument consists of two thin slips of brass AA, separated from each other at their extremities by two little bits of brass or iron. Between these slips, so put together, is a groove through which other slips of brass BB and CC are passed; BB moving backwards and forwards like a shoemaker's instrument for measuring the foot, being kept steady by a spring D. It has likewise the power of being moved upwards and downwards, which latter is the only movement allowed to the slip CC, which is also steadied by a spring. These different slips are divided into any number of inches and tenths. The application needs no description, it being precisely that of a shoemaker's instrument.

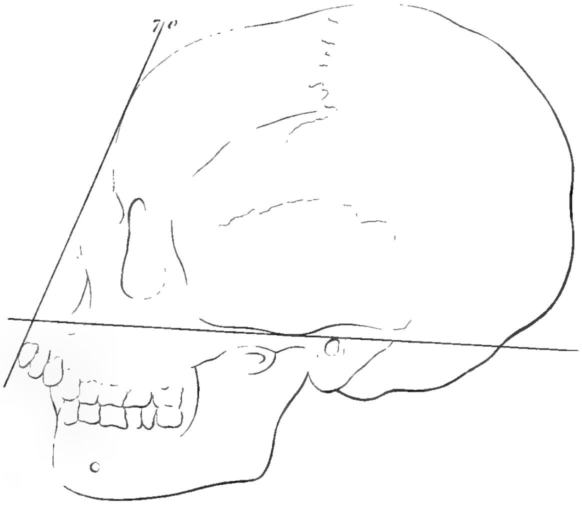
Fig. 7.

Fig. 7, exhibits Dr Leach's craniometer for measuring the superior basi-facial angle of Dr Barclay. This angle is described above. AA represent two rods of brass, one turning on a pivot B. The skull is placed in the instrument, the teeth and alveolar processes being received into the notch F, by which contrivance an imaginary line is carried through the alveolar processes parallel with the palatine plate: (This notch may be closed by the slider E.) When the skull is in this situation, the rod AC is made to rest on the bones of the nose and forehead, (or on the junction of the nasal and superior maxillary bones); the end C showing the degrees of the angle on the semicircle D, without farther trouble. (W. E. L.)

CRANIOSCOPY, (from κρανίον *the skull*, and σκοπέω *to speculate*) is a science which teaches us to investigate the eminences produced in the cranium by the brain, and to discover, by such examinations, the particular part of the brain in which the individual organs, influencing our passions or economy, reside.

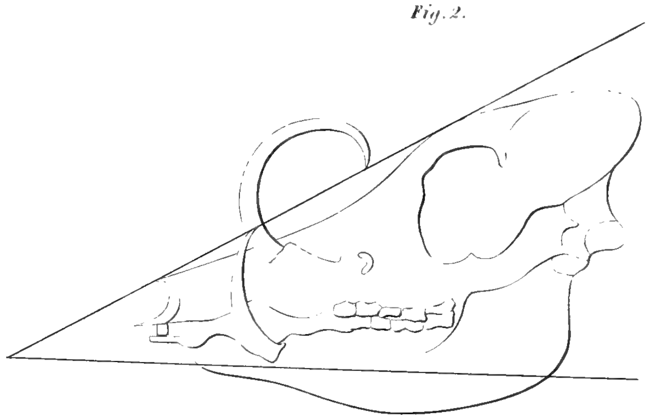
CAMPERS FACIAL LINE.

Fig. 1.



BASI FACIAL LINE.

Fig. 2.



NORMA VERTICALIS OF BLUMENBACH.

Fig. 3.

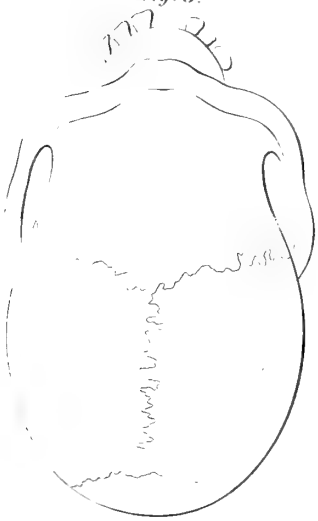


Fig. 4.

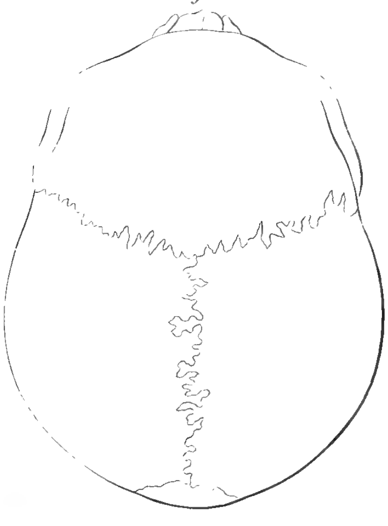
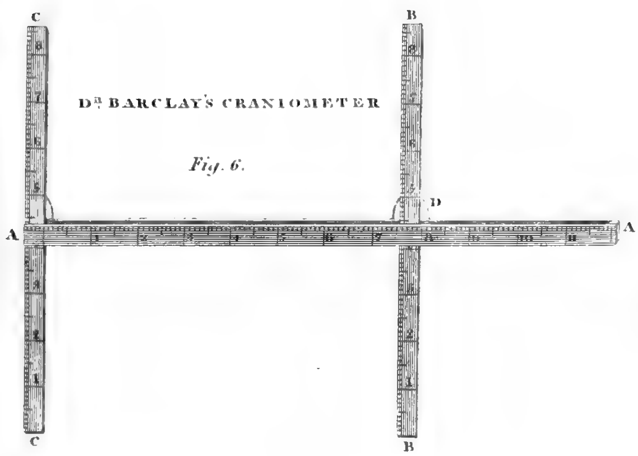


Fig. 5.

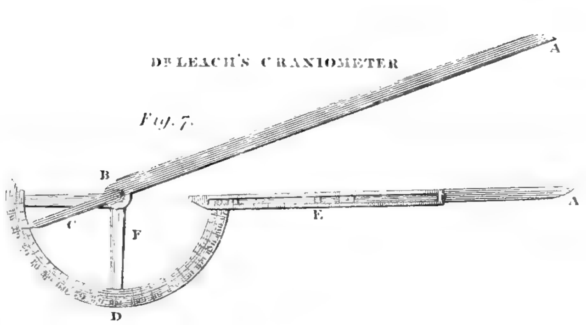
D[r]. BARCLAY'S CRANIOMETER

Fig. 6.



D[r] LEACH'S CRANIOMETER

Fig. 7.



Drawn by D[r]. Leach for the Edin[r]. Encyclopaedia.

Eng[d] by J. Moffat Edin[r]

1. History of the Science.

This science is of very recent date, but as it is a subject which has excited a considerable interest, not in the public mind alone, but amongst the most eminent philosophers, we conceive it highly deserving a place in the present work. It was first proposed as a science by Dr Gall, a German physician of very considerable abilities, who, in the early part of his life, is said to have paid great attention to the study of natural history, employing his spare time in collecting animals and plants, and arranging them from their external characters, regardless of the systems of others, (of which he was probably ignorant). From these early habits of investigation, he very soon noticed a general form in the heads of such of his fellow-students as resembled each other in disposition and pursuits, which suggested the possibility of discovering the intellectual characters of individuals from an examination of the cranium. On minute investigation, however, he found the fallacy of his opinions, in consequence of which he retracted his general inferences, and directed his attention to the individual parts of the skull; at the same time calling in the aid of comparative anatomy; losing no opportunity of collecting skulls of every description, both of men and animals; and obtaining casts in Paris plaster of living characters of eminence. As his knowledge increased, he delivered lectures on the subject, until his fame reached the ears of the Austrian government, who, under the fatal administration of bigotted priests, thought proper to prohibit him from lecturing, because his doctrines were supposed to lead to materialism and atheism. He was, therefore, compelled to travel to the northern parts of Germany, and, in his route, he lectured at Dresden, Berlin, Halle, Jena, Gottengen, &c. and as his partizans were very numerous, and much in his interest, he was welcomed to the first tables, which enabled him not only to extend his observations, but to converse with learned men on the subject of his doctrines. He is now in Paris, where his abilities are duly appreciated, and he meets with the most liberal encouragement, not from scientific men alone, but from the French government; and, after a long series of years spent in laborious investigation, and in the collection of facts, he thinks himself justified in submitting the result to the public, which he is now doing in a most splendid work in the French language, entitled, *Anatomie et Physiologie du Système Nerveaux en général, et du cerveau en particulier; avec des Observations sur la possibilité de reconnoître plusieurs Dispositions Intellectuelles et Morales de l'Homme et des Animaux par la Configuration de leurs Têtes*, par F. J. Gall et G. Spurzheim. Vol. 1. *Anatomie et Physiologie du Système Nerveaux, en général, et du cerveau en particulier in quarto avec 17 planches in folio, et in duodecimo point planches.*

2. Gall's Opinions on the Anatomy of the Brain.

Before entering into a minute detail of particular organs, it may not be improper to give a slight sketch of the opinions entertained by Dr Gall, respecting the general anatomical structure of the brain. He is of opinion, that the encephalon, or brain, is not, as has generally been supposed by anatomists, a pulpy substance, but a membrane; and he infers this, from observing the unimpaired state of the intellectual faculties in the disease called *hydrocephalus internus*, where the brain is sometimes so much compressed, as to be scarcely a line in thickness. The spinal marrow too, which is generally said to be an elongation of the brain, he imagined must have an uninterrupted communication with it, from observing paralysis of the extremities from injuries of the hemispheres, and he was fortunate enough to verify this hypothesis, and to trace the connection. This is declared to be false by Professor Walter; but the writer of this article, in a recent brain, once saw this connection traced, and has no doubt that, under favourable circumstances, it may always be made out; but the brains we meet with in our dissecting rooms, are in too bad a state to admit of any accurate or useful investigation. The medulla spiralis is composed of nerves, and, like the brain, is divided into two equal halves, which again may be subdivided into fasciculi, separated from one another by a grey substance, which probably is appropriated to nourish and strengthen the nerves. This nervous stem grows stronger and larger as it proceeds upwards, until it terminates within the skull, and then the whole expands like the branches of a tree; thus, the nerves originate where anatomists have supposed them to terminate; the nerves being formed before the spinal marrow; the medulla spinalis before the brain; hence nerves are found where there is no spinal marrow, and in new born infants, the latter was observed to exist, by Gall, whilst there was no appearance of brain. Gall commenced his examination of the encephalon at the base, beginning with the cerebellum and spinal marrow, employing a blunt instrument, by this means unravelling the convolutions of which it is composed; and never using a knife or sharp instrument, which destroys its beautiful texture, and renders it one mass of confusion. The general results of his examinations tend to show, 1st, That the whole of the medullary substance of the brain and cerebellum consists of nervous fibres, which are nourished, intimately connected, and strengthened by the cortical substance, which is composed of ganglia. 2d, That the nerves, which constitute the essential part of the encephalon and spinal marrow, are of two kinds: 1. the excurrent; 2. the recurrent; all of which take their origin from the spinal marrow, and terminate in it; consequently, the medullary part of the encephalon is derived from the spinal marrow, and the cortical part is the superficial ganglion of the brain and cerebellum; and that all the excurrent nerves terminate in the outer surface of the cortical substance on which the tunica arachnoides rests, while all the recurrent take their rise at this place.

3. Physiology of the Brain.

The brain is universally allowed to be the organ of thinking, but thought is but a general term, including a vast number of intellectual phenomena, and the brain is a very complicated organ. Shall we then, says Gall, rest contented with the general assertion, that the brain is the organ of mind? He considers it as a congeries of distinct organs, the existence of which distinguish the different individuals hardly less from one another, than man is himself distinguished from other animals. Amongst various proofs of the real existence of separate organs in the brain, are the following: 1. The sense of fatigue, arising from the mind having been long employed in one subject of contemplation; and the relief and delight we experience in variety: this cannot have escaped the observation of the most cursory observer. 2. The degrees in which the different

Cranioscopy

faculties are possessed by the same individuals; and the evident superior strength of certain organs, which causes one man to be a poet, another a statesman, or a general, &c. 3. The loss of certain faculties and powers of mind, from wounds, diseases, &c. affecting certain parts of the brain. The functions of the brain are threefold; 1. organic life; 2. sensitive life; 3. intellectual life Gall to each of these assigns a particular organ: it is in consequence of the size of the hemispheres (the part appropriated to intellectual life) that man has the largest brain: and not because the size of the human brain is greater in proportion to the rest of his body, nor on account of the comparative thickness of the nerves, as Soemmering has observed. The hemispheres of the brain are developed, in different classes of animals, in proportion to their intellectual faculties, and they are more perfect in man than in any other animal hitherto discovered. This assertion, that man is endowed with the largest brain, ought not to be mistaken; for the elephant and several other animals, have a much greater brain than man; Gall only asserts, that the hemispheres in man are larger in proportion to his size; and that the nerves are always in proportion to the economy of the animal to which they belong; thus the optic nerve is much larger in graminivorous than in carnivorous animals, whereas the olfactory is much stronger in the latter; hence it appears, that animals are furnished with such organs as are necessary or best suited to their mode of life, and are consequently born with certain dispositions and inclinations, for the exertion of which they have received certain instruments, by means of which they hold an intercourse with the external world; these organs reside in the brain, the place of rendezvous of all the single organs; each innate disposition having an organ of its own, which is increased in proportion to the power residing in the disposition, and are expressed in the surface of the brain, and form certain protuberances in the exterior osseous cover of the cranium, by which the existence of these organs may be ascertained under certain restrictions; and from these observations the system of *cranioscopy* arises. These dispositions may, in some measure, be further developed by education and connection with the world, but can by no means be created by them; or certain organs which would be productive of evil to the individual possessing them, may in a great measure be repressed; for instance, if a young man has a melancholy turn of mind, full of nervous sensibility, conscious, and scrupulous, in whom also the organ of theosophy is found, Gall would recommend him not to follow the bent of his inclination, the profession of divinity, but to lead an active life, and to mix much with gay society; and this he asserts, would in a short time effect a change and permanent cure.

Organs peculiar to the human cranium.

The organs peculiar to the human cranium are, according to Gall, twenty-seven in number. These he divides into three classes.

I. Those by which man is enabled to enter into connection with the external world.

II. Those by which we are enabled to acquire a more intimate acquaintance with the world, or with certain objects which are made known to us by means of the external senses.

III. Those which constitute the peculiar prerogative of the human race, and which raise man more eminently above all other animals in the creation. All these lie on the vertex and glabellar portion at the os frontis, that feature considered by the poet as the glorious characteristic of humanity. The forehead rises in animals as they are advanced in the scale of intellect; but it is in some species of men alone that the glabella assumes that graceful swell, which Blumenbach observes *is no less beautiful to the eye of taste, than significant to the physiognomist.*

Particular Organs of the Brain.

Particular organs of the brain.

1. *The impulse to propagation, or organ of sensual love;* which is the most important, resides in the cerebellum, and comprises that part of the occipital bone, which lies below the linea semicircularis inferior, towards the great occipital hole: it is discoverable in living subjects by the thickness of the neck, and is always more prominent in the male than in the female. As the sensual passion arises, this part is developed; and when by castration the purposes of nature are defeated, this organ ceases to grow. In such as undergo the operation at an early age, the back of the head ceases to grow; the neck is narrow, and the voice looses its manly vigour. The thickness of the neck, in consequence of the large size of the cerebellum, is particularly observable in the bull and stallion. It is farther observed, that ossification increases as the brain diminishes; thus, if the horns of a stag be cut off in the rutting season, the animal loses its power of procreation, in the effort of nature to reproduce this substance; and it does not recover its generative power till the antlers are reproduced. Many phenomena, in cases of disease, tend to prove the existence of this organ: wounds of the back of the head will produce inflammation, and sometimes impotence; and in hydrops cerebri the power of generation remains undisturbed, whilst all the other functions of the brain are deranged; from a very natural cause, the cerebellum suffers least in this disease. Cretins, who are notorious for their lasciviousness, but scarcely possess the common intellectual powers, have their cerebellum remarkably large. The bust of Raphael, which was made from an impression in Paris plaster, has a very large protuberance behind, announcing that tendency of his constitution, to which he fell an early victim. Gall relates the case of an insane man who had a fixed idea that he had six wives, and his cerebellum was found remarkably distended at his death; and states, that on entering an hospital in which he had never been before, he heard a woman uttering the grossest obscenities: he desired his assistant, Dr Spurzheim, to examine her head, declaring that he would relinquish his doctrines, if her head was not found remarkably large behind, and he was not deceived.

2. *The organ of parental love and filial affection,* is placed at the upper part of the occiput, and is most intimately connected with the impulse to propagation, and hence the organ of parental love is situated immediately above it. It is found in all animals that are fond of their young, but is always more apparent in the female than the male. It is so evident in the human species, that the sex of a child at birth may be known by this single criterion. This organ is also expressive of filial love, and is in some measure developed in boys: it however dwindles away in time, in the same proportion as the affection of parents decreases for their children.

We now leave the inial part of the head, and proceed by the lower plane of the brain to that part of it which is situated in the glabella, where nature has placed those organs which the new-born animal needs, to get more immediately acquainted with exterior objects. These organs are placed near each other, and the inclinations combined with them, produce the possibility of first knowing things at large, then to compare them with one another, the relations of space, persons, colours, sounds, and numbers.

3. *The aptness to receive an education,* situated on the middle of the glabella, immediately above the nose. It exists in all animals that can be tamed.

4. *The organs of locality,* are situated on the superciliary ridge of the forehead, on each side of the organ of aptness to receive an education. It is observed in the heads of astronomers, in whom it is particularly conspicuous, and is generally attended with a prominent organ of numbers. It denotes an aptness of apprehending the proportion of space, and an inclination to all those arts and sciences, which chiefly depend on the perception, measurement, and proportion of space. Is often found in the heads of good landscape painters and surveyors of land; also in such as are said to possess an acute eye or good look, that is to say the skill to survey a bit of ground with quickness and precision. It further shews a disposition for wandering from one place to another, and is particularly prominent in the stork and other birds of passage. The capacity which animals have of following their masters, as well as of returning to their home, seems to depend on their influence, and not to scent alone, as many facts are known which do not admit of that explanation Gall relates an instance of a dog which was taken to England from Vienna, which soon escaped from its new owner, went alone to the port, contrived to get on board a vessel, accompanied a gentleman to Mentz, whom he there deserted, and took his course alone to Vienna. In men this organ operates variously; but in every instance is connected with a disposition to observe the relations of space. It generates a love for travelling; and all persons thus organised have a most surprising skill in finding their way in strange places. The portraits and busts of the most eminent travellers and navigators are marked by this organ.

5. *The recollection of persons.* This organ is placed within the cavity of the eye, and is much wrapped in obscurity. Gall observes that it is seldom very visible, because in the forehead are many more organs which counteract its effects.

6 *The disposition for colouring.* This organ forms a protuberance in the middle of the eye-brow, immediately by the side of the organ of locality. When much enlarged, it gives the eye-brow a peculiar arch. This is particularly evident in the skulls of eminent painters. The skill of colouring, says Gall, does not depend on the eye alone; for if that were the case, all such as have a good sight would be possessed of it.

7. *The organ of sounds,* appears above the exterior arch of the eye-brow, and sometimes extends backwards immediately over the organ of mechanical skill. It likewise includes a sense for time and rythmus.

8. *The organ of arithmetic,* is situated on the exterior angular process of the os frontis, immediately above the cavity of the eye; bounded on the inside by the organ of colours, and behind and above by the organ of sound. Whenever it is found in a high degree, there arises a swelling by the sides of the eyes towards the temples, giving a square form to the head. It is confined to man; hence the skulls of other animals are not so broad in front as those of man.

9. *The organ of words, or memory,* is situated on the upper and hinder part of the cavity of the eye, and proves its existence in the living subject, by forcing the eye downward and forward.

10. *The organ of languages,* or aptness to penetrate quickly into the genius of a language, or of stating our ideas in a clear and precise manner, is situated interiorly above the eyes, and shews itself by pressing the eye deep under the eye-brow downwards, and often occasions a swelling underneath the eye towards the nose. It exists in animals who have the power of making themselves understood to individuals of the same species by language.

11. *The organ of mechanical skill* occasions an arched elevation on the os frontis, below the place where the organs of thieving meet.

12. *The organ of friendly attachment* has its residence by the side of that of parental affection, and is expressed by two protuberances on both sides, towards the ear, where the parietal bones meet in the middle with the occiput, close by the sutura angularis.

13. *The organ of valour* is found in those most apt to fight and quarrel, forming an hemispherical protuberance on the lower and hindmost angle of the parietal bone, behind and above the ear.

14. *The organ of murdering* is situated about an inch behind, and a little above the zygomatic process of the temporal bone in man. It is found protuberant in all carnivorous animals, but is never visible in such as live on vegetables.

15. *The organ of cunning* is found on the lower angle of the parietal bone, about the breadth of three fingers above the meatus auditorius, and is confined anteriorly by the organ of larceny, and above by the organ of circumspection, behind and below by the organ of murder.

16. *The organ of larceny* is bounded on one side by the organ of sounds, below and before by the organ of mechanical skill, above by the organ of inference, behind by the organ of cunning. It denotes a propensity to utter cunning, and by means of it to deprive others of their property.

We are now come to those organs which are placed in the back of the skull.

17. *The organ of height* is situated between the inial and coronal aspects of the head, about the middle of the sutura sagittalis, behind and underneath the organs of perseverance, and between the organs of ambition: it is of an oblong shape, and was first observed by Dr Gall in a beggar, who lived upon begging, from a conviction that he was above receiving any instruction; he afterwards found it in children who mount chairs and tables, that they may appear as tall as others, also in such animals as live in cliffs and mountains; he called it the organ of height, to indicate at once all the inclinations dependant on it.

18. *The organ of ambition or vanity,* is situated by the side of the organ of height, in the inial angles of the parietal bones. It is more often distinctly expressed in women than in men, and is always found in the skulls of ambitious or vain persons.

19. *The organ of circumspection* is placed in the middle of the parietal bone, and imparts an aspect to the corono-inial part of the skull. These organs are found in all animals that act with particular caution. It is very evident in the deer, more so in the wild goat, and in rooks it is particularly prominent. In such men as are entirely destitute of this organ, that part of the skull where it resides is sloped back; it then indicates giddiness and thoughtlessness.

All the organs hitherto enumerated, are common to those animals known under the general title of quadrupeds. There are others, however, which are peculiar to man alone, which indicate more exalted faculties of mind, and distinguish him from all other animals; these organs must, therefore, reside in a part of the brain of which inferior animals are deprived; and it is that mass of brain which lies behind the upper front part of the forehead, which, as we have before observed, is peculiar to some species of man alone. This spot may be considered as the partition between man and all other creatures.

20. *Comparative perspicuity.* This organ is found in the middle of the glabella, immediately above the organ of memoria realis, or aptness to receive education; being bounded on each side by the organs of metaphysical perspicuity, and behind by the organ of good nature. It is found in the skulls of eminent lawyers, and in those men who have the skill of convincing people by similes. Gall observed it in several ecclesiastics that were known as popular preachers, who knew to persuade their audience by imagery, comparisons, and paraboles.

21. *The organ of metaphysical perspicuity,* was observed on the skulls of Socrates, Kant, Mendelsohn, Fichte, and many more deep thinkers, over the whole forehead, not quite on the top, being situated on each side of the organ of comparative perspicuity.

22. *Wit.* This organ is situated between the organs of metaphysical perspicuity, theosophy, of theft, and of sounds.

23. *Organ of inference* exists in such great men, as are enabled to arrange their ideas with precision and ease. It arises from the confluence of the organs of perspicuity, deep thinking, and wit. It causes the whole upper part of the forehead to bulge forward. It has been observed by Dr Gall in the heads of Boerhaave, Haller, &c. and by the writer of this article in the skulls of Hunter, Burke, Fox, Stewart, and other great men possessing capacious and comprehensive minds.

24. *Good nature* is placed on the corono-glabella portion of the middle of the os frontis. It is very conspicuous in the heads of good-natured persons and domestic animals, as the greyhound, &c.

25. *Theosophy,* or *godliness,* is placed on each side of the organ of good nature. It is of rare occurrence. When found, it causes a swelling in that part of the cranium, often combining with the organ of good nature, causing the hair to divide, and fall down on each side of the head. Gall observed a tendency to baldness in such as possessed this organ, of the existence of which he has no doubt.

26. *Perseverance,* resides on the coronal, on the angles formed by the junction of the coronal and sagittal sutures.

27. *Mimicry,* is placed on the coronal aspect, on the inial portion of the os frontis iniad of the organ of perseverance. It is always found in the skulls of mimics and eminent comedians. It is very conspicuous in the busts of Garrick and others.

We have now enumerated the organs supposed by Dr Gall (at the time he lectured at Dresden) to belong to the human cranium; on the truth of which we shall not hazard an opinion, but refer such of our readers, as wish a more minute account, to the following works: *Anatomie et Physiologie du Systême Nerveaux en general, &c.* par F. J. Gall et G. Spurzheim. *Lettre de C. Villers a G. Cuvier, sur une Nouvelle Theorie du Cerveau,* Mentz 1802. *Edinburgh Review,* No. iii. Art. 15. *Representation of Gall's Theory of the Brain and Cranium,* by C. H. Biscroff, professor of anatomy at Berlin, with remarks by Dr C. W. Hufeland, director of the Medico-chirurgical College, Berlin, octavo, in German. *Some Accounts of Dr Gall's new Theory of Physiognomy, founded on the Anatomy and Physiology of the Brain and form of the Skull,* London, 8vo. 1807. An analysis of this pamphlet may be seen in the *Edinburgh Medical and Chirurgical Journal* for July 1806. An anonymous work entitled, *Dr F. J. Gall's System of the Functions of the Brain, extracted from Charles Augustus Blode's Account of Dr Gall's Lectures held at Dresden, translated from the German, to serve as an explanatory attendant to Dr Gall's figured Plaster Skulls.*

We cannot conclude, without noticing some of the objections urged against this hypothesis of Gall. He has been accused of describing prominences on those parts under which there is no brain. Thus the root of the nose and eye-brows assume a shape of greater or less prominence, according to the size of the frontal sinuses, which vary greatly in different individuals; yet over these cavities he places the organs of memory and colours; and over the spine of the frons, the organ of aptness to receive an education; and his organ of music, on the external angular process of the same bone. It is farther asserted, that, on contemplating the surface of the hemispheres in the situation pointed out by Gall, we meet with no prominences where he describes these organs to exist, but find the brain to present an uniform and general convexity. We have now given the opinions of Dr Gall, and the principal objections brought against them by his opponents. Our limits, however, will not allow us to discuss the point, as we could wish. Indeed we are very unwilling to say more on the subject, until we have perused his last work, and heard his last opinions, which would have considerable weight in terminating the dispute. (W. E. L.)

CRANIUM, from κρανιον, *the skull,* is that division of the head which contains the brain. Some derive the name from κρανος, a helmet, because it protects the brain as a helmet does the head. In different authors the following synonymes occur, *Calvaria, Cerebri galea, Testa,* or *Scutella capitis;* κογχος, κυτος, and σκαφιον.

For an anatomical account of the cranium, see ANATOMY; and for an account of the national varieties, see MAMMALIA. We shall now make some general remarks on the skulls of animals in general. An obvious and very striking difference exists between the heads of man and all other animals, consisting principally in the relative proportions of the face and cranium, which are made obvious by the facial, and basi-facial angles. The facial angle (as we have before observed in the article CRANIOMETRY) is greatest in man. The face of animals is situated more antiniad than in man; and the cavity of the skull is so diminished in size, that its anterior or glabellar portion is soon lost as we recede from man. Hence the facial line is oblique, aud the facial angle is acute, and it becomes more so as we descend in the scale from man; and in some birds, and most reptiles and fishes, is lost altogether, as the cranium and face are completely on a level, and form parts of one horizontal line. The idea of stupidity is always associated with an elongation of the face, which lowers the facial line; hence the snipe and crane have become proverbial. When, on the contrary, the facial line is increased, with no expansion of the cranium, as in the elephant and owl, by the cells which separate the two tables, the animal acquires a particular air of intelligence, and gains the credit of qualities which he does not possess. Hence the latter animal is selected as the emblem of Minerva, and the former is distinguished (as we are told) in the Indian language, by a name which indicates an opinion that be participates with man in his most distinguishing characteristic, the possession of reason. The ancients (as we have already mentioned under CRANIOMETRY) were well acquainted with these circumstances, and have extended the facial angle of their heroes and philosophers to 90°, and that of their gods to 100°.

The foramen magnum occipitale in man, is placed in the basilar aspect of the head, near the middle, being but little iniad of the middle part of the base, and its direction is nearly horizontal. As we descend in the scale of beings it recedes iniad, and in the lower animals we find it situated in the inial aspect. This was first noticed by Soemmering. The situation of this foramen is admirably adapted to the economy of the animals, and the positions they assume in walking. In proportion as the volume of the brain increases in comparison to the whole body, so does the occiput become more convex and prominent; and the foramen magnum is removed farther from the inial aspect, and the level of this opening approaches the horizontal direction. This position of the opening, which places the head in a state of equilibrium upon the neck, and brings the face forwards in the natural erect position, would, if man went on all fours, prevent him from elevating the head sufficiently to see before him, because the motion of the head would be stopped by the projection of the occiput meeting the cervical vertebræ.

As the situation of the occipital hole differs very considerably in various animals, it has become a matter of importance to distinguish by some determinate rule its variation; for this purpose let a line be drawn along the level of this opening; it will pass from the inial edge of the foramen, along the surface of the condyles, and if continued anteriorly, will terminate just under the orbits. It forms a short and almost horizontal line, which intersects, nearly at right angles, the vertical line of the body and neck, when the head is held straight, being neither inclined backwards or forwards.

The difference in the direction of the foramen may be estimated by noting the angle formed by the union of a line drawn in the manner above-mentioned, according to the direction of the opening, with another line passing from the posterior edge of the foramen to the inferior margin of the orbit. Their angles is of 30° in man, and of 37° in the orang-outang. The same angle which is termed the *occipital angle*, is 47° in the lemur, and 90° in the horse.

Other differences, existing in the teeth, upper jaws, &c. are noticed as characters by which man is distinguished from other animals. For a more particular account of these distinctions, see ANATOMY, MAMMALIA, and TEETH. (W. E. L.)

CRANMER, THOMAS, archbishop of Canterbury, was born at Aslacton, in Nottinghamshire, July 2, 1489. His father, who bore the same name, was a gentleman of a family which for many ages possessed Cranmer Hall in Lincolnshire, and is said to have been able to trace his pedigree to the time of the conquest. The advantages of a well-directed education, which young Cranmer improved, formed at a very early period his manly character, and laid the foundations of his future fame. His admittance into Jesus College, Cambridge, when only 14 years of age, opened up a wide field for the exertion of his keen and piercing intellect; but though the range of his understanding was only bounded by the whole circle of science, yet religious, and, in particular, biblical knowledge, was his favourite pursuit. A fellowship, and a degree of master of arts, were the honourable rewards of his abilities and industry; but the former he forfeited by marrying a lady to whom he was tenderly attached; and he immediately after became reader in Buckingham College. The happiness which he enjoyed in the fond affection of a kindred spirit, was cruelly terminated by the death of his wife, which took place a short time after his marriage; but if his affliction could have been soothed by the love and esteem of the good, he must have found some consolation in the admiration of his friends, who again dignified him with his fellowship in the university, an honour almost unprecedented. Refusing a fellowship at Oxford, which Cardinal Wolsey offered him, he took the degree of doctor in divinity, 1523, and, in consequence of his integrity and learning, was appointed to give lectures on theology, and to examine the candidates for academical honours. Even in that age of comparative darkness, the penetrating mind of Cranmer, though still entangled with the bewildering dogmata of papal superstition, had learned, from an intimate acquaintance with the scriptures in their original language, not merely to despise as useless, but to detest as destructive of the beauty and the power of religion, all those distinctions without difference, all those technical phrases without meaning, and all those definitions of things undefinable, which composed the lifeless body of school divinity, and which, in some degree, are blended with the systematic religion of the present day. Hence, as he refused degrees in divinity to every person who was ignorant of the language and doctrines of scripture, he became, at first, obnoxious to the ignorant and the ambitious; but, in a short time, many of those who most bitterly reproached him, were filled not only with admiration of his virtues, but with gratitude for the happiness which he had conferred upon them.

To fulfil Cranmer's future destiny, he was forced by the plague, which broke out at Cambridge, to visit a Mr Cressy, an intimate friend of his, who resided at Waltham Abbey. Whilst he enjoyed there the pleasures of literary friendship, Henry VIII. who, in 1529, sought to divest his mind from the disappointment which he experienced in his divorce from Catharine of Arragon, took a tour through part of his kingdom, and happened on his return to stop at the house of Mr Cressy. Here Dr Fox, the king's almoner, and Dr Gardiner, then secretary, afterwards bishop of Winchester, met with Cranmer at supper, and as the king's divorce became the subject of conversation, Cranmer, from that acute discernment which he naturally possessed, observed, that whilst they paid such unlimited regard to the ecclesiastical law, the business would never be terminated: the question was simply, "whether a man may marry his brother's wife?" This could be decided by scripture only; and if the universities of Europe were consulted respecting the doctrine of scripture on this point, the affair would soon be over; for if the scriptures permitted it, the conscience of the king would be at rest; and if they did not permit it, the authority of scripture, supported by the suffrages of all the learned bodies in Christendom, would compel the pope to pronounce a definitive sentence agreeable to scripture. Fox and Gardiner, struck with the force of the observation, resolved to communicate the information to the king; and justice requires that we should state, that whilst the latter invidiously proposed to conceal the author, and take the merit of the discovery to themselves, the former generously rejected the unmanly proposal, and fairly revealed the scheme and its author to Henry.

From this moment, Cranmer's history becomes, in a great measure, identified with the history of England. As the narration of public events belongs much more properly to the annals of the kingdom, than to the biography of the man, we shall touch but slightly upon those circumstances which must compose a prominent part of the history of that important period, and confine ourselves chiefly to the private events of the individual.

Cranmer had left Waltham, before Henry was informed of his advice; but the king was so enraptured with the design, that he sent an express for him to Nottinghamshire. He, with that modesty which was natural to him, reluctantly obeyed; and soliciting in vain to be excused from appearing before the king, had an interview with his majesty. Pleased with his candour and discernment, the king made him one of his chaplains, requested him to write upon the divorce, and desired the father of Anne Boleyn, now Earl of Wiltshire, to allow him, at Durham Place, to pursue his design. From every source of legitimate reasoning, Cranmer established the important truth, that the pope possessed no power to dispense with the word of God, and not only by the unanswerable work which he published, but by public disputations, he gained almost every person of discernment to his opinion.

When the English universities had declared the marriage unlawful, an embassy, composed of the most learned men of the nation, among whom was Cranmer, was sent to Rome, to obtain, if possible, the pope's consent. This proved unsuccessful, from the political views of his Holiness, who, however, to conciliate all parties, as far as his double policy could go, bestowed upon Cranmer the office of penitentiary. From Rome, Cranmer went through Italy, France, and Germany, where, according to the custom of the age, he maintained the cause of his master in many public disputations. At Nuremberg, he married a second wife, the sister of the famous Osiander. On his return, March 13, 1533, the king conferred upon him the archbishoprick of Canterbury, and procured from the pope the bulls necessary for his consecration; but as he now began to embrace the opinions of the reformers, he refused to take the customary oath of obedience to his Holiness. He was at last, by the importunity of the king, prevailed upon to comply, by adopting an expedient which had been proposed to him, doubtful, at least, in principle, and dangerous in practice, but an expedient to which his mind perhaps was the more easily reconciled by the sentiments of the age, as well as by the common practice of that church which he wished to abandon. This was nothing else, than to enter a solemn protest, before he took the oath, that he did not intend by it, to restrain himself from any thing that he was bound to, by his duty to his God, his king, or his country. On the 23d May of the same year, he pronounced the sentence of divorce between the king and queen. The pope, upon this, threatened him with excommunication. He, in return, promoted the reformation to the utmost of his power; and was the principal mean of abolishing the pope's supremacy, by act of parliament—of procuring a new and more correct translation of the scriptures—and of suppressing the monasteries. In 1536, he, in compliance with the will of the king, dissolved the marriage of Henry and Anne Boleyn; but though at her death the hopes of the Catholics revived, yet the means which they employed to counteract the reformation, and to withdraw from Cranmer the affection and confidence of the king, had a contrary effect. Hence the *constitutions*, which were enacted this year by the convocation, corrected many errors respecting purgatory and images; but they determined a point of still greater importance, when they declared the scriptures to be the standard of faith. But the triumph of truth was soon blasted, by an act of parliament in 1539, for abolishing diversity of opinion in religion—an act which, by its being sanctioned by the gibbet and the flames, was emphatically called the *bloody statute*. This, though approved by the king, was framed by the artful and insidious suggestion of Gardiner, bishop of Winchester, whose spirit it breathes; and which, by denouncing all who denied transubstantiation, the celibacy of the clergy, &c. must have fallen chiefly upon the reformers. With a modest, but manly fortitude, which must exalt the dignity of Cranmer's character in the eyes of all capable of appreciating truth and freedom, he opposed the enactment of this statute with all his eloquence and authority. Even when required by the king to leave the House, he refused, by declaring, that he was bound in conscience to vote against it,—a declaration which his enemies fondly hoped would for ever ruin him with the king; but which, in reality, gave the king such a high idea of his integrity, that he respected and trusted him the more. But though he opposed the law in the House, yet he complied with it so far, when passed, as to send his wife to her friends in Germany, till better days should arise. In 1540, he received the royal commission to provide for the advancement of religion, by explaining its principal doctrines, which he performed by the publication of a work entitled, "A necessary Erudition of any Christian Man;" a work which the votaries of Rome endeavoured in vain to answer.

We cannot refrain from bringing forward here an event, which will shew the malevolence of the primate's enemies, and the affection of the king. It is well known, that Henry persecuted, with the same severity, the opinions of reformers and Catholics, when they differed from his own; and that every person who would not subscribe his creed was a heretic. The natural consequence of free inquiry, was a variety of opinions; and Gardiner and his adherents, taking advantage of this, endeavoured constantly to impress the king with the belief, that Cranmer was the sole cause of the growing mischief. To repress at once their insinuations, which continually teazed him, he appeared to enter into their views, and permitted them to summon the archbishop to appear before them next day. At midnight, however, he sent Sir Anthony Denny to request Cranmer's immediate attendance in the gallery, and in all the confidence of friendship informed him of their machinations, and advised him not to commit himself to their mercy by any unguarded concession; "for he would not have any better luck with the false knaves than his master, Christ, had." At parting, he gave him a ring from his finger, as a pledge of his protection; and Cranmer retired, so deeply affected with the king's goodness, that he scarcely refrained from tears. When summoned next morning to attend, he obeyed, and his enemies were so confident of success, and so insolent in their malice, that they refused him admittance to the council-chamber, till Dr Buts, the king's physician, informed his majesty that the primate of England was thus degraded like a foot-boy. When admitted, he was charged with heresy, and with protecting heretics; and was ordered to be committed to the Tower. The production of the ring was a stroke of thunder to his enemies. Equally abject in adversity, as proud in prosperity, they first broke out in reproaches against each other, and then in apologizing to the king; who told them, that he thought his council had been composed of wiser and better men, than to persecute the only person of integrity among them. After the death of Cromwell, Earl of Essex, whose execution the generous friendship of Cranmer laboured in vain to prevent, he retired to the duties of his clerical office; and left the court to those who, by their ambitious and crooked policy, were better calculated for rooting in that polluted soil. The king, however, not forgetful of his integrity and moderation, appointed him one of his executors; and in his last illness sent for him from Croydon to assist him in his preparation for eternity. Before he arrived the king was speechless; but as a proof that he knew him, he pressed his hand and expired.

Though Cranmer placed the crown upon the head of Edward VI. and was nominated one of the regents, yet he interfered in civil affairs only when they were connected with religion. But as the mind of the prince had fully imbibed the principles of the reformed, the designs of the Archbishop were no longer impeded by the caprice of royal authority; yet, as he had many and powerful enemies, he proceeded in the work of reformation with a firm and steady pace, but at the same time, with a prudence which the more ardent of his party blamed. It is with real pity, and even indignation, that we see a mind, naturally mild, generous, and intelligent, still so embittered with the unrelenting spirit of bigotry, as to wield the sword of persecution, and to imprison Gardiner, Bonner, and some others, for their attachment to Popery. But what must be our feelings, when we contemplate him directing the secular power against Joan Bocher, commonly called the Maid of Kent, who denied the divinity of Christ. Her moral conduct was irreproachable, and with a constancy and courage which ought to have commanded the admiration of her persecutors, she refused to purchase life, by abjuring what she believed to be the voice of revelation, but what her enemies denominated a damnable heresy. She was sentenced to the flames; but to the eternal honour of Edward, his mind revolted against signing the warrant for her execution, declaring, that to burn any for conscience sake was a piece of cruelty too like that which the reformers condemned in Papists; and when Cranmer urged him to comply, "What, my lord!" was his animated and emphatic question, "Will you have me send her quick to the Devil in her error?" By the persuasion of the primate, in an hour fatal to his fame, the generous feelings of the prince were overcome, and he signed the warrant with tears, protesting, that if he did wrong, his advisers must answer for it to God.

In 1551, Cranmer followed the example of other reformed churches, and under his direction, if not with his assistance, a Confession of Faith was prepared, the new liturgy was corrected, and the articles of the Church of England, forty-two in number at that time, were established by law. But the hopes of the reformers were soon disappointed by the premature death of Edward, in 1553, who, however, in his last illness, in order to secure the ascendancy of the reformers, was prevailed upon to devolve the crown upon Lady Jean Gray. Cranmer refused to sign this settlement as a counsellor, but did it as a witness; a distinction of doubtful interpretation, though it is probable that he acted in this manner, not so much from an aversion to the deed itself, as from the fear of its consequences, as he afterwards composed one of her council. The accession of Mary, and the change of religion which immediately followed, banished, with respect to the reformers, mercy and even justice from the throne. Cranmer had now nothing to expect but the most unrelenting persecution; and, with a fortitude and a dignity, which, though seldom found with such moderation and prudence, he knew upon great occasions to display, refused, at the earnest solicitation of his friends, to seek his safety in a foreign country. The honour of his own character, the interests of truth, he said, imperiously commanded him to remain firm at his post; and to vindicate the changes which he had adopted in religion, he determined to wait the consequence. To deprive him not merely of life, but even of reputation, was resolved upon by his enemies. For this purpose, Bonner, bishop of London, degrading himself more than the victim of his resentment, burst out every where in spiteful railleries against Mr Canterbury, as he was pleased to call him, and published a report that the archbishop, in complaisance to the queen, had promised solemnly to abjure his errors. Into a snare thus cunningly prepared, and dexterously concealed, the wounded indignation of Cranmer betrayed him; and the refutation of this calumny which he published, and in which he called upon the queen to attest his innocence, sealed his doom. He was cited before the star-chamber; he owned the publication, and, contrary to the expectations of all, was pardoned by the queen. This lenity strikingly discovers the casuistry of Mary. Cranmer had generously interposed with her father, when he had resolved to put her to death for her adherence to her mother, and as she owed her life to him, she thus discharged her debt of gratitude, with the fixed resolution of afterwards demanding from him her full debt of vengeance, which she well knew she could enforce. Three days after his liberation, he was committed to the Tower, where he remained till 1554, when, with his fellow-prisoners, Ridley and Latimer, he was conducted to Oxford, to dispute publicly with the leaders of the Catholics, at whose head was Weston, prolocutor of the convocation. The court party, by this exhibition, designed to expose and degrade the three venerable reformers; and this they accomplished by shutting their ears to truth, and silencing their opponents by insult and tumult; and they terminated this solemn mockery of truth and justice, by pronouncing them heretics, commanding them to abjure their heresy, and excommunicating them upon their refusal. But, as the power of this court extended no further, in September 1555, Cranmer was brought to a second trial at Oxford, before Dr Brooks, bishop of Gloucester, and sub-delegate to the Pope, Dr Martin, proxy to the king, (Philip of Spain,) and Dr Story, proxy to the queen. That he had been twice married; that he had published heretical books; that he had forsaken the church of Rome; and that he denied transubstantiation, were the horrid crimes which were laid to his charge, which he confessed; and to answer for which he was cited within eighty days to appear before the Pope. When we say, that he was immediately remanded back to prison, it will not be necessary to add, that he did not obey the citation; but without recollecting the spirit of his persecutors, posterity will scarcely believe, that on the 14th February, Bonner and Thirleby were sent to degrade him for non-obedience. Though he defended himself with great eloquence and spirit, and protested against the injustice of a sentence condemning him for not appearing at Rome, whilst they detained him in prison, Bonner proceeded to the work of degradation with unrelenting cruelty. To expose him to ridicule, the archbishop of Canterbury was arrayed in pontifical robes made of coarse black canvass; these were taken off him piece by piece, according to the ceremonies appointed in such cases by the church of Rome; and a sentence adjudging him to the flames was pronounced. The patience and fortitude which he displayed, contrasted with the insolence and cruelty of Bonner, not only melted Thirleby into tears, but will transmit to posterity the name of the former with deserved infamy!

His immediate execution would have prevented Cranmer from clouding the evening of his days by an unavailing dereliction of principle. Unfortunately for his fame, he was remanded to prison: there he was assailed by the treacherous promises of his enemies, who assured him of pardon upon his gratifying the wishes of the queen; and by the no less urgent solicitations of his friends, who conjured him to relax his unbending spirit, and to yield to the storm, with which it was in vain to contend. In the gloom of confinement and of solitude, the dread of perishing amid the flames shook his virtuous resolution; the love of life, and the hope of being useful to his country, awakened in his bosom; and in an evil hour he signed that recantation of his religious principles which has to the present moment inspired men with grief or with exultation, according as they have been the friends or the foes of the reformation. The victory which the treachery of his enemies had gained, their malice knew how to improve. His recantation was printed and circulated with the utmost assiduity; the queen, that he might not have time to return to a better mind, resolved upon his immediate execution; and a warrant, to that purpose, was signed on the 24th February. This his enemies designed to conceal from him, but he suspected their design, and prepared for the consequences. On the 21st March, he was conducted in solemn procession to St Mary's church, Oxford; he was placed upon a platform raised opposite to a pulpit, where Dr Cole, provost of Eton, was appointed to preach before him a sermon suited to the occasion; and whilst the preacher deferred his appearance, that the fallen victim of superstition might be fully exhibited to the mockery of his enemies, he turned his venerable face to a pillar that was behind him, in all the wretchedness of degraded dignity. The mean and the tattered garments which covered him; the agony of his soul, which appeared in every feature of his countenance; the silent prayer which, in the bitterness of his spirit, he poured out to the Friend of the afflicted; and the awful circumstances in which he was placed, exhibiting an affecting instance of the instability of human greatness, might have softened the heart even of his persecutors. Dr Cole, however, at last ascended the pulpit, and after expatiating, with insulting malignity, on the errors and the punishment of the enemies of religion, he turned to the wretched victim of his cruelty, and thanking God for his return to popery, which he attributed to the agency of the divine Spirit, he assured him that his death should not be comfortless, as the priests there present would pray for his departing soul; but as a proof of his sincerity in returning to the bosom of the church, he commanded him to read aloud the abjuration of his errors. The aged primate, who stood an image of sorrow and contrition during this scene of insult and cruelty, with a firm and manly voice, professed his belief in all that the scriptures reveal to man; but, added he, "that which I wish chiefly to mention, that which wounds my conscience more than all the sins of my life, is, that, contrary to truth, and the dictates of conscience, I abjured the religion which I had embraced from the deepest conviction; and to repair, as much as is in my power, the majesty of truth which I have shamefully violated, I now renounce all the errors, which, in opposition to my better judgment, my hand has subscribed; and, as a mark of my detestation of my crime, the hand which committed the deed shall be first consumed in the flames which you prepare for me!" The spectators, who imagined that the sorrow which he displayed had arisen for the crime of apostatizing from popery, no sooner heard this declaration, than they loaded him with the most barbarous execrations. Dr Cole, with the wildest fury, cried out to stop his mouth! to pull him down! to drag him to the flames! His commands were obeyed with the most savage inhumanity. When he was chained to the stake, he bade the multitude, who reproached him, farewell; and perceiving one Ely, formerly an intimate friend, and a fellow of the same university, standing near, he offered him his hand, but he refused to touch so vile a heretic. He then stretched his right hand amid the flames that now rose around him, exclaiming, This is the hand that did it! Once only he removed it, and drew it across his forehead; and returning it again, he held it firm till it dropped from his shoulder. Unmoved like a statue, he stood with unshaken fortitude, and when the fire seized upon his vitals, he raised his eyes to heaven, and uttering the words of Stephen, "Lord Jesus, receive my spirit!" sealed his testimony by his death.

Such was the fate of Thomas Cranmer, Archbishop of Canterbury, in the 67th year of his age. Had he fallen in better days, his life would have exhibited every virtue which can adorn the man, or dignify the Christian; and he would have descended to the grave without those shades, which circumstances of peculiar difficulty threw upon the fulness of his fame. The praise and love of his friends are not a more decisive proof of his distinguished learning and abilities, than the reproach and hatred of his enemies; and the arts and labours which the votaries of Rome have employed to blacken his character, evince how skilfully he wielded the powers of a superior mind against the foundations of their church. Mild, modest, temperate; he conciliated the affection, without rousing the envy of those whom he surpassed in the race of civil or ecclesiastical preferment; and the noble stand which he made in defence of the Duke of Norfolk, his constant and determined enemy, when attainted by Henry contrary to justice, raised a column to his integrity and generosity which will never be shaken. With a mind patient in the investigation, piercing in the discovery, and ardent in the love of knowledge, he was admirably qualified to detect error, and to appreciate truth; and the intimate friendship which he cultivated with men of learning, as well as the patronage and protection which he extended to every branch of science, proved, that he beheld in others with pleasure those qualities upon which depended his own fame. But, whilst we love and admire the mild and splendid virtues which he possessed in an eminent degree, we are not blind to the failings and weaknesses which attended them. That he uniformly employed his influence to moderate the passions and soften the asperities of Henry's temper, will not, at all times, justify his complaisance to the wishes of that monarch. That he was open and sincere in his attachment to truth, will hardly excuse the manner in which he took the oath of allegiance to the pope, and signed the will of Edward; though it must be confessed, that had he made no scruples upon these occasions, we perhaps would never have blamed him, though his candour and integrity would have been less. The prudence, moderation, and generosity, which never failed to shed a dignity over his political conduct, will not atone for the imprisonment of the Catholics, far less for the death of Joan of Kent. His acts of persecution, however, must, in some measure, be imputed to the age in which he lived, and the church in which he was educated; and we cannot suppress a remark, which forcibly struck us when recording his interview with Edward, when he signed the warrant for Bocher's execution, that the youthful mind of that prince, who had imbibed without mixture the pure doctrines of scripture, felt the generous and liberal spirit of Christianity more than the learned and venerable Archbishop, whose mind still retained the traces and the temper of opinions, which had been deeply impressed upon it in a darker age. We can enter too into all his feelings, and sympathize with the weakness of human constancy, yet when we consider the distinguished eminence on which he stood in society, we are astonished that he could stoop to purchase the very dregs of life by an abjuration of principle; and we turn with a melancholy triumph to the noble and undaunted fortitude, which his closing scene presented to obliterate the remembrance of his fall. See Gilpin's *Life of Cranmer*. Bloomfield's *History of the Martyrs*. Fox's *Martyrology*. Strype's *Memorial*. Rapin's *History*. Burnet's *History of the Reformation*. Hume's *Hist. of England*. *Biog. Brit.* (N)

CRASPEDIA, a genus of plants of the class Syngenesia, and order Polygamia Necessaria. See BOTANY, p. 310.

CRASSULA, a genus of plants of the class Pentandria, and order Pentagynia. See BOTANY, p. 168.

CRASSUS. See ROME.

CRATÆGUS, a genus of plants of the class Icosandria, and order Digynia. See BOTANY, p. 229.

CRATÆVA, a genus of plants of the class Dodecandria, and order Monogynia. See BOTANY, p. 223.

CRATERIA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 222.

CRAX. See ORNITHOLOGY.

CRAYONS. See DRAWING.

CREAM. See DAIRY.

CREATION. See COSMOGONY.

CREDITON, commonly called *Kirton*, is a market town of England, in Devonshire, situated on the river Crede or Creedy, in a rich soil between two hills, the southernmost of which overlooks the tops of the houses. The town is about a mile long, and is divided into the east and west parts, the latter of which was nearly destroyed by fire in 1743, and also in 1769, when several new buildings, and the market house and shambles, were consumed. The church, which was once a cathedral, is a fine and spacious Gothic building, about 150 feet long and 44 broad. It has the form of a cross, with a tower 100 feet high, rising from the intersection of the nave and transept, and standing upon a semicircular arch, supported by four enormous pillars. The tower contains eight bells, and a clock with chimes. The east and west windows are very large, and ornamented with tracery, and the interior of the church is neatly finished. The altar piece, which is esteemed an exquisite piece of painting, represents Moses and Aaron sustaining the decalogue, and extends through the whole height and breadth of the chancel. Over the south porch there is a small library, and there is a Sunday school connected with the chancel.

There is a good free school at Crediton, founded by Queen Elizabeth, and also a charity school for 40 poor boys and girls. The principal manufacture is that of serges, which are sent to Exeter to be finished and exported. Great quantities of wool and yarn are sold at the weekly market, which is held on Saturday.

The population of the burgh, in 1811, was,

Inhabited houses	425
Number of families	464
Ditto employed in agriculture	44
Ditto in trade and manufactures	369
Males	704
Females	1142
Total population	1846

See Polywhele's *History of Devonshire*, and Britton and Brayley's *Beauties of England and Wales*, vol. iv. p. 279, 280. (*j*)

CREED. See CONFESSION.

CREEKS. See GEORGIA.

CREMATION, is a term generally applied to the ancient custom of burning the dead. In our article BURNING, where we have given a full account of this custom, we have referred to the present article for an account of the ceremonies which accompany the burning of the living; but this subject will be more properly treated in our article INDIA, where we shall have occasion to treat at considerable length of the manners and customs of the Hindoos.

CREMONA, a town in the kingdom of Italy, and principal place in the department of the Po, is situated in a beautiful plain watered by the Oglio, and about a quarter of a mile from the north bank of the Po. The city is large and well built, and occupies a space about five miles in circumference. The principal streets are straight and spacious, and the town is adorned with some small squares, and several palaces.

The principal public buildings are the cathedral, St Peter's church, the Dominican church, the Augustines church, the town hall, or the public palace, and the university. The cathedral, which is of Gothic, or rather mixed architecture, was begun in 1107, but was not wholly completed till the 14th century. The front is lined with red and white marble, and is highly and fancifully ornamented. The chapel appropriated for the relics of the primitive martyrs, is a small though perfect edifice. It is simply and chastely decorated, and contains the urns and sarcophagi in niches regularly arranged on each side of the chapel, like the ancient Roman sepulchres. The cathedral contains several fine paintings and altars, and a handsome monument erected to the memory of Cardinal Francesco Sfondrato, decorated with fine bas reliefs. Before the entrance of the cathedral are two lions, each supporting a pillar. The baptistery, which is separate from the cathedral, is a large and lofty octangular edifice with two galleries round the upper part of it. It contains, in the centre, a curiously wrought font cut out of an immense block of party-coloured marble. The tower, which is very high, of a singular style of architecture, is ascended by 498 steps, and commands a fine view of the town, the various roads that cross the country, the Po intersecting the extensive plains of the Milanese, the Alps to the north, and the Appennines to the south west, covered with snow. Among the paintings in the cathedral, the crucifixion, by Pordemoni, is particularly admired. The principal paintings, however, were carried off to Paris when the town was taken by the French.

St Peter's church, which belongs to the canons regular, is a handsome edifice, adorned with many elegant paintings. The Dominican church contains a superb altar made of *lapis lazuli*, agate, and beautiful marble; and in the area before the church is a statue of St Dominic holding a cross in his right hand, and in his left a dog with a lighted torch in his mouth. This church contains likewise some fine paintings. The convent of the Augustines has a good library, and their church possesses some valuable paintings. The university of Cremona was long ago in a declining state.

A canal, which passes through the town, forms a communication between the Oglio and the Po, over the latter of which rivers is a bridge of boats, defended by a fort. The fortifications of this town consist chiefly of a wall with some bastions, and surrounded with a ditch, which is filled with water from the canal.

Cremona was once celebrated for its knives; and its violins and other musical instruments, which are held in high estimation, form a considerable article of commerce. Its principal exports are silk, corn, flax, oil, honey, wax, brandy, and Parmesan cheese, and its imports are linen cloth, silks, sugar, coffee, &c. Population 21,000. East Long. 10° 2′ 12″, North Lat. 45° 7′ 43″. See Keysler's *Travels through Germany*, &c. vol. iii. p. 337. Denina's *Tableau de la Haute Italie*, p. 249; and Eustace's *Classical Tour through Italy*, vol. i. p. 115, 118. (π)

CREMONA STOP, in music, is a simple reed stop, or consisting of only one range of pipes, that are tuned to their own or to the diapason pitch, the same as the finger-keys indicate, which is not the case with several even of the simple stops on the organ: its name is supposed to be a corruption of the ancient instrument krum-horn, which this stop, when first introduced, was said to imitate. (ę)

CRENÆA, a genus of plants of the class Dodecandria, and order Monogynia. See BOTANY, p. 223.

CREOLES. See BUENOS AYRES, vol. v. p. 60, 61, 62, and CHILI, vol. vi. p. 203.

CREPIS, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See BOTANY, p. 290.

CREPUSCULUM. See ATMOSPHERE and TWILIGHT.

CRESCENT. See HERALDRY.

CRESCENTIA, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 248.

CRESSA, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 160.

CRESSY. See BRITAIN.

CRETE, one of the islands in the Grecian archipelago, and renowned in ancient times for the fertility of its soil, the number of its inhabitants, and the wisdom of its laws. Under CANDIA, its modern appellation, we have given an account of its geography and present state; and in this article, we propose to confine ourselves entirely to a view of its ancient inhabitants and history. In entering upon this subject, however, we do not pretend either to reconcile the discordant accounts of ancient authors, or to unravel the mythological fables by which the early history of this island is so completely obscured. This would be a task more arduous even than to trace the windings of its famed labyrinth without the clue of Ariadne; and would lead us into disquisitions neither very interesting nor instructive.

At an early period of the world, Crete had made great advancement in civilization, while the other states of Greece were immersed in ignorance and barbarism. It possessed a free and regular government; and a system of laws which has been the admiration of succeeding ages. But what were the steps by which this island had arrived at such an extraordinary superiority over the surrounding nations, it would be in vain to enquire. Every account that has been received from the ancients, is completely involved in allegory and fable. Written records at that early period were unknown, and consequently all our information respecting it rests entirely upon vague and uncertain tradition. Most of the absurdities that have been embodied into the Heathen mythology had their origin here; and Crete may be justly said to have been the cradle of the gods. Such of their princes, as were distinguished for their wisdom, their valour, or their beneficence, were after their death raised to the rank of deities; and the high esteem in which the Cretans were held among the other inhabitants of Greece soon gained them admission into the worship of their more barbarous neighbours. Indeed it may be safely affirmed, that there is scarcely a divinity in the whole system of Grecian theology that did not receive his title and his honours in the island of Crete. It is to be regretted, however, that so little is known with certainty concerning this civilized people. Before the Trojan war, when they were in the height of their glory, their history is dark, and unintelligible; and since that time they have never been considered as of any weight among the Grecian states. Except in the war of Troy, the Cretans took no interest in the general affairs of Greece, nor do they seem to have been influenced by the many memorable events that were transacted in that country.

The original inhabitants of this island, according to the traditions preserved by Diodorus Siculus, were the Idæan Dactyli, who are supposed by some authors to have come from Mount Ida in Phrygia. They had also the name of Curetes, says Strabo, from their being entrusted with the care of Jupiter when an infant; and are said to have discovered the use of fire, and the art of working metals. They also taught men to dwell in houses, instead of the forests and caverns of the mountains; and to tame wild animals, and make them subservient to their wants. They instructed them in the use of the bow and the sword, and were the inventors of military dances. But the most famous were the Titans, who, according to ancient fable, were descended from Uranus and Terra, or, as some say, from one of the Curetes and Titæa, from whom they derived their name. Many of them were renowned for their wisdom and warlike achievements; and from them sprung a race of gods, goddesses, and heroes, an account of whose virtues and crimes constitute almost the whole of the Grecian mythology; or, what is more properly termed by some, the fabulous history of Crete. But whether any of these were the aborigines of the island, or whether Crete had any other inhabitants distinct from them, has not been decided by historians. Indeed, the whole seems to be little better than merely matter of conjecture; and Strabo, after a learned disquisition on the inhabitants of Crete, says, "I am not fond of fables, yet I have entered into a long detail of these, because they have a relation to theology."* However this may be, we are told that they were in after ages called Eteo-Cretans, to distinguish them from foreigners, who, invited by the fertility of the soil and

* Strabo, lib. x.

Crete.

the beauty of the climate, had settled here from all parts of the Grecian continent. Homer, in the Odyssey, enumerates four distinct nations inhabiting Crete besides the natives, all using different dialects, and all apparently free:

> There is a land amid the sable flood
> Called Crete; fair, fruitful, circled by the sea,
> Numerous are her inhabitants, a race
> Not to be summ'd, and ninety towns she boasts.
> Diverse their language is; Achaians some,
> And some indigenous are; Cydonians there,
> Crest-shaking Dorians, and Pelasgians dwell.
>
> Cowper's *Homer's Odyssey.*

According to Eusebius, the first king of the island was called Cres, from whom it received its name. He is said to have been one of the Curetes, and was the author of many useful discoveries, which contributed to the happiness of his people. Of his successors, however, little is known. Their names and their actions are equally lost in allegory; and it would be but unprofitable labour to attempt to draw them from their obscurity. Rhadamanthus and Minos alone deserve to be named; the former as being the first legislator of the Cretans, and as having laid the foundation of their admirable polity; and the other as having many ages after raised the superstructure with such wisdom and success.

The system of laws, of which they are supposed to have been the authors, are well-known through the fame of Sparta; and while the history of the Cretans has been lost, a general account of their polity has been handed down to us by the most respectable authorities. It is considered as the general fountain of Grecian jurisprudence and legislation; and, according to Plato, "was founded upon those solid principles which cannot but render the people who are subject to them flourishing and happy." † The Cretan laws had all a reference to war. To cultivate among his subjects a spirit of unanimity and patriotism, and to inspire them with a love of liberty and military glory, seem to have been the principal objects of the legislator. Courage and noble actions were the only road to honour, and vice was invariably stigmatised with hatred and disgrace. It was not, however, by a multitude of legal enactments, or by the arm of power, that Minos attempted to accomplish his purpose. He had too just a knowledge of the human heart to suppose that these were sufficient to restrain the heedless impetuosity of youth, or the confirmed depravity of manhood; and he therefore endeavoured, by a wise system of education, to destroy the very knowledge of vice, as an object that was to be shunned and despised, by training the infant mind to the love and the practice of virtue.

The Cretans were divided into two classes; that of the youths who had attained their seventeenth year, and were called *Agetas* (companies), and that of the men of mature age, named *Andreia.* As freemen, they were all considered as equal. A community of meals was established at the public expence, where they all partook of the same diet, and were habituated to sobriety and temperance. There the rich and the poor were seated together. They knew no distinction but that of virtue; and we are told that a woman presided at each table, and publicly distributed the best of every thing to those who had distinguished themselves by their courage in war, or their wisdom in council. This honour from the hand of beauty was greatly prized by all, and excited emulation in every breast, to render themselves worthy of the same reward. When the repast was finished, the old men discussed the affairs of the state, discoursed of the history of their country, celebrated the actions and virtues of their great men, recounted the battles in which they had been engaged, extolled the exploits of the brave, and exhorted the youth to similar deeds. It was in those assemblies that the young men were first inspired with the love of virtue and fame. The Cretan boy, at seven years of age, was admitted into the society of the men: and seated on the ground, and clad in a simple garb, he listened in silence to their conversation and counsels. There the patriot and the hero were depicted in such glowing colours, as excited his youthful admiration. He longed to emulate their conduct; and having the most eminent examples of wisdom, justice, and moderation continually before his eyes, he was led to cherish the love of virtue before he had contracted any of the habits of vice. From their infancy the Cretans were inured to deprivations and hardships. They were accustomed to be content with little, to suffer hunger and thirst, and to disregard the rigour of the seasons—to climb mountains and precipices, to bear with resolution the blows or wounds they might receive in the gymnastic exercises; and to make a dexterous use of the bow, the sling, and the sword. They were also taught to commit to memory, and to sing to a particular air, the laws of Minos, which were written in verse, and to repeat hymns and poems in praise of their heroes, or in honour of their gods. At seventeen they were received into the class of the youths, whose exercises were more difficult and severe. They now employed themselves in running, wrestling, and fighting in mock combat, while martial airs were played upon the lyre, to which they were obliged to keep time. These combats, according to Strabo, ‡ were not without danger, as they often made use of iron weapons. But the most common exercise, and in which they were most ambitious to excel, was the Pyrrhic dance. The dancers wore the warlike dress, which consisted of a light jacket that descended to the knee, and was fastened with a girdle that went twice round the waist; and completely armed, they imitated various military evolutions to the sound of instruments. This exercise, which was strictly enjoined by the laws, they considered almost as dishonourable to neglect as to quit their post in the day of battle.

When their young men had completed their education, and had attained the proper age, they were received among the Andreia, by which they became entitled to vote in the national assemblies, and might be chosen to any employment of the state. At this period they were obliged to marry; and even this institution was regulated by the laws. The Cretan married not for himself, but for the state. His bride was chosen by the magistrate, who was guided entirely by a reference to the security of the nation. The stout and handsome youths were joined to young women who resembled them in constitution and figure, without any regard to passion, opulence, or poverty, but merely that a robust race might be produced, that would defend and do honour to their country. Thus by making every institu-

† Plato *de Legibus*, lib. i.

‡ Strabo, lib. x.

tion have a relation to war, a nation of soldiers was formed, all exercised and expert in the use of arms, and capable of defending their property and independence. They were particularly distinguished for their skill in archery; and "the arrows of Gortyna," (a city of Crete) says Claudian, "when happily directed, carry certain wounds, and never miss their aim." Crete at last became so famous among the Grecian states, that it was considered as the best school for learning the military art; and many foreigners resorted thither for that purpose. "Philopœmon," says Plutarch, "being ardently desirous of acquiring knowledge in the profession of arms, embarked for Crete; where having exercised himself among that warlike people, well versed in every military art, and accustomed to lead a frugal and austere life, he returned to the Achæans, and so much distinguished himself by the knowledge he had acquired, that he was appointed commander of the horse."

Minos has been greatly blamed for making war the principal object of his institutions. But it should be remembered, that as he considered liberty to be the best foundation of a nation's happiness, it was necessary that his subjects should be formed capable of maintaining it against every opponent; and it may be observed, that though the system of his laws throughout breathe a martial spirit, yet no prince could be more averse to foreign conquest. Unprovoked warfare, he considered as a system of violence and injustice, which, instead of aggrandising or promoting the happiness of the victorious nation, tended rather to enfeeble it, by wasting its resources and corrupting its morals. Minos, therefore, endeavoured to keep his people continually employed in gymnastic exercises, in the pleasures of the chace, and in public shows; and thus by banishing idleness, he prevented the wish of seeking imaginary glory by foreign conquest. But in the midst of warlike exercises and athletic amusements, the fine arts were not forgotten; but appear rather to have been encouraged and cultivated with great success. Ptolemy* says, the Cretans were even more anxious to cultivate their minds, than to exercise their bodies; and they displayed their munificence to Homer, by giving him a thousand crowns. Thales of Gortyna, the instructor of Lycurgus, was an eminent philosopher and poet; and so great was the effect of his poetry, as we learn from Plutarch,† that when exhorting the people to unanimity, they found their understandings, hearts, and ears, equally persuaded and charmed; and enamoured with the blessings of peace, which he painted in the most lively colours, gradually suffered their animosity to subside. The poet Epimenides, who was so highly esteemed at Athens in the time of Solon, was likewise a Cretan, as were also Ctesiphon, and his son Metagenes, who displayed such admirable skill in building the celebrated temple of Diana at Ephesus. The Cretans regularly frequented the solemnities of Greece, and some of them are immortalized by Pindar‡ as victors in the Olympic, Nemean, and Pythian games.

Minos, like many other ancient lawgivers, pretended that his laws were not the dictates of men, but the suggestions of the Deity, and consequently ought to be received with the utmost submission and respect. He often retired into a cave in Mount Ida, where he boasted of having familiar conversations with Jupiter; and one of his institutions, which Plato considered as the most admirable, was, that young men were not to indulge an indiscreet curiosity respecting the laws; nor examine whether he did right or wrong to enact them, but were to obey them because they proceeded from the gods. If any defects should be observed in them by the old men, they were commanded to address themselves to a magistrate, or to discuss the subject with their equals; but never in the presence of young people.

It is, however, rather a reproach to this wise legislator, who in his institutions studied so much the happiness of his subjects, and put such a high value upon liberty, that while the Cretans lived in honourable freedom, a larger portion of mankind was for their sakes doomed to irredeemable slavery. All the labours of agriculture were performed by slaves and mercenaries, who were obliged to pay a certain annual tribute to their masters, from which were first deducted the sums necessary for the exigencies of the state. They were called *Periœci*, "apparently," says Mr Rollin, "because they were taken from the neighbouring people whom Minos had subdued." But Mr Mitford is of a different opinion, and says, that "it is difficult to account for the first establishment of such a system, but upon the supposition that an Egyptian or Phœnician colony, seizing the lands, like the Spaniards in the West India islands, deprived the inhabitants of arms, and compelled them to labour." We are assured, however, that they were treated with mildness and humanity; for it was an ancient custom in Crete, which was afterwards followed by the Romans, that, at the feast of Mercury, the masters waited upon their slaves at table, and rendered them the same service as they received from them the rest of the year;—"precious remains and traces of the primitive world," says M. Rollin, "in which all men were equal, that seemed to inform the masters, that their servants were of the same condition with themselves, and that to treat them with cruelty or pride, was to renounce humanity."

The monarchical form of government in Crete after the Trojan war, gave place to a republic. Idomeneus the grandson of Minos, who, together with his cousin Merion, conducted eighty ships to the siege of Troy, was probably the last of its lawful kings. At his departure, he is said to have committed the government to Leucus his adopted son, with the promise of his daughter Clisitheia in marriage, if he ruled with wisdom until his return. But Leucus, taking advantage of his long absence, seized upon the throne, after having murdered Queen Mida and her daughter, as the only impediments to his advancement; and when Idomeneus landed in Crete after the destruction of Troy, the usurper, at the head of his partizans, compelled him to return to his ships.§ It is probable, however, that Leucus did not long enjoy his exaltation, for soon after the flight of Idomeneus, we find the monarchy at an end. A republic succeeded, which consisted of ten magistrates and thirty senators. The magistrates held their office only for one year, and were elected in an as-

* Ptolem. *in Tetrab.* lib. ii. † *In Vita Lycurgi.* ‡ Ode xii.

§ Servius, *in Eneid*, lib. iii. who is followed by Fenelon, relates the expulsion of Idomeneus in a different manner. He states that the king had vowed, during a violent tempest, that he would sacrifice to Neptune the first head he should meet on his arrival in Crete; and that his son being the first, he slew him, which so enraged the Cretans, that they drove him from his kingdom. Herodotus, lib. vii. says, that he brought the plague with him in his ships, and that Leucus availed himself of this pretext to procure his banishment.

sembly of the people by a plurality of voices. They were called Cosmi, and had the management of the most important public business, and also the command of the armies in time of war, with absolute power, but were liable to be called to an account for their conduct at the expiry of their authority. The senators were chosen from among those who had passed the office of cosmi, and retained their dignity for life. To them were submitted all state affairs; but nothing was finally determined upon without receiving the approbation of the people. To provide for the expenses of the state, every citizen was obliged to bring into the common stock the tenth part of his revenues. Part of this was applied to the uses of religion and the salaries of the magistrates, and the rest allotted for the public meals. So that all the inhabitants were fed at the expence and in the name of the republic. This form of government was highly extolled by Plato. "The republic," says he, "which approaches too near to a monarchy, and that which admits too unrestrained a liberty, are equally remote from the just medium. O Cretans! O Lacedæmonians! ye have avoided these two rocks, and established your states on the most solid foundation." *De Legibus*, lib. iii.

The republican form of government continued in Crete as long as it remained a distinct nation; and the laws of Minos subsisted in all their vigour in the time of Plato, more than nine hundred years after their first establishment. But though the Cretans retained their freedom, and were so far true to their laws as never to attempt foreign conquest, yet they were continually distracted by internal dissensions. Many of its principal cities had early formed themselves into so many independent republics, who were jealous of each other, and constantly at war. Of these, the most powerful were Cydon, Cnossus, and Gortyna. The two latter, sometimes at variance with each other, wasted the flower of their youth in unavailing contests, and sometimes in alliance attempted to subjugate the neighbouring cities. Cydon alone opposed a determined resistance to their ambition; and, after the greater part of the island had submitted to their power, successfully withstood their united forces. By one of their laws, however, the Cretans were enjoined to unite all their strength whenever a foreign power should attempt a descent upon their coast; and it has been remarked, that they never agreed but when they went to beat off a common enemy. On such occasions, all private animosities were suspended; and being convinced, that victory depended upon the unanimity of their troops, they magnificently adorned the most beautiful young men of the army, and made them sacrifice to friendship before they engaged in battle. In this manner, the republic of Crete had maintained her liberty for ten centuries against every foreign invader. The manners of the Cretans, however, had greatly degenerated from their ancient probity and simplicity. The love of justice had given place to that of gain; and knavery and piracy had become their only occupations. Their character, indeed, had become proverbially infamous, and Κρῆς πρὸς Ἀιγινητην, had nearly the same import as our "set a thief to catch a thief." But the Romans were now extending their conquests over the world; and the Cretans having been accused of favouring the enemies of Rome in the war against Mithridates, their subjugation was determined upon, and war was immediately declared. Marcus Antonius (the father of the triumvir,) was accordingly appointed to conduct an expedition against this island, but he and the greatest part of his fleet were cut off by the Cretan pirates, who hung up their prisoners to the masts, and returned triumphant into their harbours. On the following year, however, Quintus Metellus landed a formidable army on their shores, and after an obstinate and bloody struggle, which continued for three successive years, and in which many of the Romans and the bravest of the Cretan warriors fell, he reduced them to submission, when the laws of Numa were immediately substituted for those of Minos. "From that period to the present time," says M. Savary, "the Cretans have ceased to be a nation, and have gradually lost their courage, their virtues, their sciences, and their arts. So true is it that man is born for liberty, that, deprived of this support, which he has received from nature to sustain his weakness, his genius expires, and his courage languishes, till he sinks to the lowest point of degradation."

The island of Crete was celebrated in ancient times as containing a hundred cities, whence it was called *Hecatompolis*. Forty, however, are only mentioned by Ptolemy; and of these the most distinguished were Cydon, Cnossus, Gortyna, Lyctos, Hiera-petra, Eleuthera, Præsos, Rithymna, Heraclea, Apteron, and Arcadia. See *Ancient Universal History*, vol. viii. p. 212; Rollin's *Ancient History*, vol. v. p. 204; Mitford's *History of Greece*, vol. i. p. 13—176; Savary's *Letters on Greece*, p. 144, &c.; Sabbathier's *Institutions, Manners*, &c. *of Ancient Nations*, vol. i. p. 235. (*p*)

CRETINS. See COMPLEXION.

CREWKERNE, a market town of England, in Somersetshire, is situated in a pleasant wooded valley, on the branches of the rivers Parrot and Axe. The town consists of five principal streets, the houses in which are old and irregular, and its chief buildings are the church, the market house, two alms houses, and two charity schools. The church is an elegant and highly ornamented Gothic structure. It has a body and transept, with a handsome embattled tower sustained by huge pillars. Behind the altar is a room which was formerly a confessional, but is now used as a chancel house. It has a door on each side for the ingress and egress of the penitents, and over the entrance door is a swine, to denote the polluted state of the sinner before his confession, and over the other door are two pigeons, emblematical of the purity with which they go out. The market house, which is large, stands in the centre of the town. It has some manufactures of sailcloth, stockings, dowlass, and girt-web.

In 1811, the town and parish contained,

Houses,	589
Families,	618
Ditto employed in trade and manufactures,	308
Ditto in agriculture,	281
Total population in 1811,	3021

See Collinson's *History of Somersetshire*. (*j*)

CRICHTON, JAMES, a celebrated Scotch author, who, from the extraordinary nature both of his mental and corporeal endowments, obtained the name of the *Admirable* Crichton. He was born in the year 1551, or, according to some, in August 1560, and was descended from respectable parents, who resided in the county of Perth. After receiving his grammatical education in the town of Perth, he was sent to St Andrew's to study philosophy, in which he made rapid progress, under the able direction of Rutherford, Buchanan, Hepburn, and Robertson; and before he had reached his

Crichton.

twentieth year, he made himself master of the sciences of the times, he was able to write and to speak ten different languages, and had attained the greatest skill in the more showy accomplishments of riding, dancing, singing, and playing upon musical instruments.

Having thus completed his education, Crichton set out upon his travels, and paid his first visit to the French metropolis. Conscious of the superiority of his attainments, and eager to display them to the world, he publicly challenged all the celebrated men in Paris to dispute with him in the college of Navarre that day six weeks, at nine o'clock in the morning, when he should answer any question in the arts and sciences, either in prose or in verse, and in any of 12 languages, viz. the Hebrew, Arabic, Syriac, Greek, Latin, French, Italian, English, Spanish, Dutch, Flemish, and Sclavonian. During this interval of six weeks, while his antagonists were preparing for the contest, Crichton amused himself either in hunting, hawking, tilting, &c. or spent his time at balls and concerts; and yet, when the day arrived, he acquitted himself to the astonishment of his auditors, in a disputation which lasted from nine o'clock in the morning till six at night. The president of the assembly then rose from his chair, and, attended by four professors of the university, presented Crichton with a diamond ring, and a purse full of gold, in token of their admiration and esteem. On the following day he attended a match of tilting at the Louvre, and, in presence of a brilliant assembly, he carried off the ring 15 times in succession.

From Paris, Crichton went to Rome, where he exhibited himself, with equal success and applause, before the Pope and the most distinguished characters in that renowned metropolis. *

His next exhibition was at Venice, about the year 1580, where he conciliated the affections of the people by a Latin poem in praise of the city, which he presented to Aldus Manutius, and other Venetian literati. He made a brilliant speech before the Doge, and sustained disputations on various subjects with his usual success. As soon as he had recovered from an illness with which he was here attacked, and which lasted five months, he set out for Padua, and on the 14th of March 1581, he disputed with the most celebrated professors in that university, and particularly exposed the errors of the Aristotelian philosophy. The fame of this exhibition was so widely extended, that he was earnestly solicited to repeat the performance by numbers who were not able to attend before. Manutius informs us, that this second display never took place; but if we believe Imperialis, who speaks on the authority of his father who was present, Crichton did make his appearance, and disputed with Archangelus Mercenarius, who had the reputation of being a profound philosopher. In consequence of some attempts to detract from his merits, Crichton again offered to display his powers in the refutation of Aristotle and his followers, and on other controversial subjects. The disputations which took place on this occasion are said to have lasted three days, and Crichton is reported to have sustained his part with such readiness and ability, as to have extorted acclamations from the whole assembly.

Hitherto Crichton was chiefly called upon to exhibit his mental qualifications; but at Mantua, which he next visited, he had to encounter an enemy more formidable than any of the champions of Aristotle. A gladiator, who had overcome the most celebrated fencers in Europe, was living under the protection of the Duke of Mantua, and had already slain three individuals who had accepted of his challenge. As soon as Crichton heard of this prodigy, he offered to fight him for 1500 pistoles, and though the Duke remonstrated with him on the danger to which he exposed himself, and was unwilling that society should lose such an ornament, he at last agreed to the proposal, and appointed a day when the champions should fight in presence of the court. The skill and cool intrepidity of Crichton were an overmatch for the eager impetuosity of the Italian, who was at last thrice run through the body. The prize of 1500 pistoles, which the victor thus acquired, was generously divided among the widows of the three individuals whom the gladiator had slain.

Crichton.

Astonished at the qualities both of mind and body which he had witnessed, the Duke of Mantua chose Crichton as preceptor to his son Vincentio di Gonzaga; and out of gratitude for this appointment, Crichton is said to have written a comedy satirizing the various professions in which men are engaged, and to have supported 15 characters in the representation of his own play.

During the time of the Carnival, when Crichton was playing on his guitar in the evening through the streets of Mantua, he was assailed by several persons in masks. Having repelled all their attacks, he disarmed their leader, who pulled off his mask, and begged his life as being the prince, his pupil. Upon this discovery Crichton fell upon his knees, apologised for his mistake, and assured the prince that if he had any design upon his life, he might take it when he pleased. He then took his own sword by the point, and presented it to the prince, who barbarously run him through the heart. This event is said to have happened in July 1582 or 1583.

Such are the wonderful feats which our countryman is said to have performed; and if we were even so credulous as to believe them all, we should not be disposed to rank him among those men who have done honour to their country by advancing the interests of literature or science. Various circumstances, however, which it would be unprofitable to enumerate, concur in throwing a suspicion over the whole of Crichton's exploits; and we think that we are sufficiently liberal in our praise when we reduce his pretensions to those of an accomplished scholar. Versed in the ancient and modern languages, which he retained by the aid of a powerful memory, and possessed of great fluency of utterance, and confidence in his own powers, it was no difficult matter to astonish the learned pedants of the 16th century; while the elegance of his person and manners, and his other dazzling accomplishments, captivated the affections of the gay crowd, who are the dispensers of contemporary fame. The award of posterity, however, generally reduces the extravagant encomiums with which living merit is too often flattered; and he who during his lifetime has been elevated with the praises of fashionable admirers, often sinks into oblivion with the dull crowd by whom they were conferred. National partiality, and individual affection, may avert for a while the extinction of a dying name; but the impartiality of

* Boccalini, who was at Rome when Crichton visited it, states, that having been ridiculed in a pasquinade, as an empiric, he left the city in disgust.

Crichton, Crimea.

a new generation cherishes the memory only of those who have enriched literature and science with their genius, or who have enlarged the comfort and happiness of their species. The reputation of the Admirable Crichton is, we fear, of this perishable kind. The works which he has left behind him, and which have been long forgotten, exhibit no marks either of taste or genius. His accomplishments as a scholar have already received their full reward, and impartial justice has no demands upon posterity for a prolongation of his fame. The following is a list of his works: 1. *Odæ ad Laurentium Massam plures.* 2. *Laudes Patavinæ, Carmen extempore effusum, cùm in Jacobi Aloysii Cornelii domo experimentum ingenii coram tota Academiæ frequentia, non sine multorum stupore, faceret.* 3. *Ignorationis Laudatio, extemporale Thema ibidem redditum, post sex horarum disputationes.* 4. *De Appulsu suo Venetiis.* 5. *Odæ ad Aldum Manutium.* 6. *Epistolæ ad Diversos.* 7. *Præfationes solemnes in omnes Scientias sacras et profanas.* 8. *Judicium de Philosophis.* 9. *Errores Aristotelis.* 10. *Arma an Literæ Præstant, Contraversia oratoria.* 11. *Refutatio Mathematicorum.* And, 12. A Comedy in the Italian language. Several of these poems are published in the *Biographia Britannica,* to which we must refer our readers for farther information respecting the subject of this article. (*w*)

CRIEFF. See PERTHSHIRE.

CRIMEA, anciently *Taurica Chersonesus,* a peninsular province of European Russia of recent acquisition, in the new government of Taurida, formerly called *Crim Tartary.* The name of Crim, or the Crimea, has been by some derived from the ancient *Cimmerii,* but is supposed by John Reinhold Forster to have originated from the city of *Krim,* now called Stara-crim, or Eskikyrim, signifying the old citadel, denominated *Cimmerium* by the ancients. In some middle age travels, the Crimea is denominated the island of Caffa.

Name.

Situation and extent.

This peninsula is situated between the latitudes of 44° 40′ and 46° 5′, both N. and the longitudes of 32° 45′ and 36° 30′, both E. reckoning from Greenwich. It is of an irregular rhomboid or lozenge shape, lengthened out to the west, and more especially to the east, every where surrounded by the waters of the Black Sea and sea of Azof, except at its northern angle, where it joins the continent of Europe by the isthmus of Precop, otherwise Perecop, and Or-Capi, only four miles wide. From this isthmus in the north to its most southern cape or promontory, denominated *Krin Metopon* by the ancient Greeks, the extent is 124 English miles; and measuring from the western cape to the eastern promontory of Yenikale, it extends 208 miles from W. by N. to E. by S. The entire area, therefore, making every allowance for the irregularity of its shores, cannot be less than 5600 square miles, or 3,584,000 statute English acres; but the far greater proportion of the surface consists of extensive *steppes,* or comparatively desert plains.

Boundaries.

Beginning on the north at the isthmus, the north-western side of the Crimea is bounded by the gulf of Perecop, a large bay of the Black Sea or Euxine. The north-east side, from the isthmus eastwards to opposite Yenitche in the continental desert of the Nogays, is bounded by the Sivash, or Mud Sea, an extremely irregular and shallow gulf of the *Palus Mæotis,* or sea of Azof, called also Ischaback-Denghissi, and sea of Tabachi, or of Zabachi. This gulf of Sivash was denominated *Putris Palus,* or Putrid Gulf, by the ancients. It also covers most of the eastern side of the Crimea, cutting deep into its shores by many irregular shallow bays and salt marshes; and is itself singularly bounded and divided from the sea of Azof on the east, by the peninsula, or long narrow stripe of Arabat, which projects from the Crimea in the S. E. not exceeding a mile or a mile and a half in breadth, but extending north, or rather north-by-west, for seventy miles, and is only separated from the continent at Yenitche by a strait of a mile and a half broad.

Below, or to the south of this singular spit of land, a considerable projection of the Crimea, called the promontory or peninsula of Kertsch, anciently the kingdom of *Bosphorus,* extends to the east, having the sea of Azof on the north, the Black Sea on the south, and the Straits of Yenikale or Taman, anciently the Cimmerian Bosphorus, on the east, which divides it from the Isle of Taman, beyond which is Kuban Tartary. The whole southern and western coasts of the Crimea are washed by the Euxine or Black Sea.

Divisions.

This province may be divided into the Crimea Proper, the eastern subordinate peninsula of Kertsch, and the Island of Taman. The climate is subject to considerable variation, the winters being sometimes extremely severe, with intense and long-continued frost, especially in the extensive *steppes* or northern plain, which is much exposed to the north-east winds, while the season of spring is pleasant and moderate, with cool nights and serene weather. The summer is often excessively hot, and droughts of considerable endurance frequently prevail. The autumnal season is sultry, moist, and unhealthy.

More than three-fourths of the Crimea Proper, to the north, are occupied by a vast undulated plain, called the Steppes, of varying soil, without trees, being mostly composed of sand, more or less mixed with clay, and affording pasture to numerous flocks belonging to the Nomadic Tartars. This large plain or steppe abounds with salines, or salt lakes and marshes, from which abundance of salt is procured in the dry season, for supplying the inhabitants of the peninsula, and the Nogays, who wander through the steppes on the continent between the Nieper and the Don; as also for the neighbouring governments of Russia, and for Anatolia, Bessarabia, and other countries around the Euxine. So great is the abundance of this salt, which is procured without the trouble of any process, except gathering it from the dried up ponds, that two hundred vessels load with it yearly from the single port of Caffa, besides immense quantities carried inland in waggons. This salt is easily obtained, as the conductors of the immense numbers of *Kibitkas,* that resort to Perecop for this indispensible necessary, have only to drive axle deep into the shallow water, and load as fast as they please, the salt lying in heaps like sand. They are to be seen at this work to the number of hundreds at a time, the driver of each waggon, or kibitka, paying a tax of ten roubles to the crown for his load of salt. It is sent by the Black Sea to Constantinople and the Archipelago, and by land to Poland and all Russia, even as far as Petersburg and Riga. Even in the earliest periods of history, Taurica was, as now, the emporium of this commodity to all the surrounding countries.

Salt.

Soil.

The soil of this extensive flat consists partly of a white sandy clay, and partly of a black vegetable loam, and near the southern hills is mixed with chalk and limestone. It had formerly a great number of Tartar villages, wherever water could be procured for irriga-

Crimea. tion; and for this purpose the Tartars were at great pains to procure water from the distant heights, by means of canals and tunnels of clay below ground, discharging themselves into stone reservoirs, to serve the inhabitants and their cattle, and to water their cultivated land, orchards, and gardens, during the dry season. Since the Russian conquest, the Tartar population has greatly deserted the country, and the Russians have unaccountably suffered the excellent system of canals, tunnels, and reservoirs to fall to ruin, by the most culpable neglect. This comparatively level tract is said to abound in petrifactions, and the remains of marine productions of various kinds; and, though now considerably elevated above the level of the Black Sea, is said to afford strong indications of having once been entirely covered over by the waves, in which case, the Euxine must anciently have been of much greater extent, especially to the northwards. This was the opinion of Pliny, founded upon the authority of more ancient writers, who, in his account of the Chersonesus, has the following passage: " From Carcinitis begins Taurica, once surrounded by the sea, which covered all of its champaign part."

Mountains. The mountainous southern portion of the Crimea extends along the shore of the Black Sea, from Aktiar, or Sevastapol, in the S. W. to Caffa, or Theodosia, in the S. E. The principal ridges extend from east to west, their southern declivities being much steeper than their northern slopes. These hills are chiefly composed of calcareous rocks, covered by a clay soil of some depth and fertility, in some places mingled with gravel and round stones, rendering it particularly suitable for cultivating the vine, while the other parts grow wheat, rye, barley, millet, flax, hemp, and tobacco in considerable luxuriance. Some of these hills are said to have all the appearance of being formed by alluvion, while others bear the marks of having been produced, or altered at least, by the operation of fire; especially two in the subordinate peninsula of Kertsch, which are denominated volcanoes. The most elevated of these mountains are covered with snow till the end of May, and their sides are clothed with extensive forests, yielding excellent ship timber. Some of the summits in this mountainous chain are estimated at 1200 feet above the level of the Euxine, having plains on their tops, partly composed of bare rock, and partly covered by a thick stratum of earth. From Tschadir-daghi, or the Pavilion Mountain, the *Trapezus Mons* of the ancients, the prospect extends almost over the whole peninsula. Many petrifactions are found even on the tops of the mountains, and numerous caverns penetrate their sides, as is usually the case in calcareous districts; and in one of these of vast size ice remains unmelted during the whole year. No traces of metals have hitherto been discovered; but in several places they dig up a species of marle, or rather a kind of fullers earth, which is said to serve all the purposes of soap.

Productions. The lower edges of the hills, and the intermediate vallies, are productive of all kinds of grain, together with flax, hemp, and tobacco, and are beautifully diversified with gardens, orchards, and vineyards; these last more especially in the neighbourhood of Sudak, where they make an excellent wine, resembling champagne in colour, strength, and flavour. In these places, the cultivated soil consists of a thick bed of gray fertile loam resembling potter's earth, mixed with small stones and gravel. This southern tract is beautifully diversified among the mountains, with elevated plains and fine vallies, covered by the richest verdure, and interspersed with almost perpendicular calcareous rocks. Among these, the valley of Baidari, which was given to Prince Potemkin at the Russian conquest, is extolled by all travellers as peculiarly interesting and beautiful. It abounds in fine woods, especially composed of large oaks and walnut trees, interspersed with open and well cultivated fields, gardens, and orchards. In one place, an oak is mentioned as measuring thirty feet in circumference, six feet from the ground. The celebrated professor and traveller Pallas, who has enumerated a great number of plants indigenous in the Crimea, describes the vegetation of this country as being extremely luxuriant. The *crambe orientalis*, or wild horse radish, is peculiarly abundant in that part of the country which lies between the rivers Salgir and Karasu, and is often thicker than a man's arm. This is extolled by Lady Craven, as the strongest and best flavoured horse radish she ever tasted.

Locusts. The Crimea, at certain seasons, is much infested by locusts of two species, the *gryllus tartaricus* and *migratorius*, which often do much injury, by eating up the whole vegetable productions wherever they settle. The fields, the vineyards, gardens, and pastures, are all laid waste; and sometimes the only appearance left upon the naked soil is their putrefying bodies, the stench of which is enough to breed a pestilence. The large black tarantula is found of a fearful size. The phalangium arachnoides, also, an insect allied to the spider, whose bite is said sometimes to prove fatal. Centipedes likewise, the *Scolopendra morsitans* of the naturalists, are very common; and scorpions are found in the mountains.

Rivers. The principal river in the Crimea is the Salgir, with its feeders the Great and Little Karasu, or black-waters; besides which it has many smaller streams, as the Alma, Belbeck, or Kabarta, Byuk, or Kasikly-useen, Aithoder, Balganack, Badraka, Katsha, Dasta-su, Burultsha, &c. all rapid and dangerous torrents after heavy rains, but mostly rivulets only in the dry season.

Ancient kingdom of Bosphorus. The eastern promontory, or subordinate peninsula of Kertsch, anciently the kingdom of Bosphorus, differs considerably in appearance and soil from the rest of the Crimea. It measures about eighty-four English miles from west to east, by about twenty-four at a medium from north to south. The isthmus by which it is connected with Crimea Proper, of about ten miles broad, is a level plain, to the east of which the country rises into gentle eminences; and at the eastern end near Kertsch and Yenikale there are hills of some elevation. The shores of the Euxine, and Sea of Azof, all around this peninsula, are high, steep, and of difficult access. Between the hills there are several salt lakes, some of which are separated from each other by beds composed of shells and sea sand. The few and scanty rivulets of this peninsula are dry in summer; and, although there are many springs of excellent water among the hills, that which is procured by digging pit wells in the lower grounds is mostly brackish. Though destitute of natural wood, this peninsula has abundance of fruit trees in its gardens and orchards; and the soil in general, except around the saline lakes and salt marshes, is fertile and productive.

The singular stripe or spit of land, stretching from Arabat towards Yenitche, and separating the Mud Sea, Sivash, or Putrid Gulf, from the sea of Azof, formerly mentioned, is composed of shells and sand, and is most-

Crimea. ly level, with a few small eminences, being covered with rich pasture. Near an elevated sandy promontory projecting into the sea, called Kamesch-bourne, great numbers of petrified shells are found, as also a singular mineral, said to be native prussiate of iron, or Prussian blue. Salt springs are found in the hills near Yenikale, as also a spring of petroleum or rock oil. Also, on the summit of a hill in this peninsula, there is a marsh containing bitter salt water, emitting a disagreeable smell, and resting upon a black sulphureous slimy bottom; and on the leaves and stems of the vegetables growing around this marsh, liver of sulphur, sulphuret perhaps of soda, is found deposited.

Isle of Taman. The island of Taman, though not actually a part of the Crimea, is included in the same government. It is separated from the peninsula of Kertsch by the straits of Yenikale or Taman, anciently the Cimmerian Bosphorus, which bounds it on the west. The north side of this island is washed by the sea of Azof, and the south side by the Black sea, while the eastern end is separated by an irregular congeries of small saline lakes, with narrow interposed isthmuses, from Kuban Tartary. The breadth of the straits of Yenikale is from seven to twelve miles. The length of this island from west to east is about forty miles, and its breadth from north to south twenty-six. Its surface is considerably elevated above the surrounding waves, the shores being generally upwards of seventy feet high, and very steep; while at its western extremity there are several hills, two of which are said to be volcanic. The soil is in general a sandy loam, but is of clay in some places; the sloping sides of the hills and intermediate vallies being fertile, and well cultivated in some places. Though this island does not naturally produce either trees or shrubs, yet, in the vicinity of Taman, at its western extremity, there are many large orchards, in which fruit trees have long flourished in great luxuriance and productiveness. It has many springs of fresh water, but no running streams. In some places there are saline pools and salt springs, containing petroleum; and the interior of the island is said to abound in a resinous combustible substance, supposed to be composed of, or impregnated with, mineral oil or petroleum, that has been distilled or sublimed by means of subterraneous fire. Before the town of Taman there is a spacious bay of the same name, the *phanagoria* of the ancients, but too shallow to allow of being navigated by large vessels. The interior of the island is the most elevated and fertile; but some districts are represented as unhealthy, owing to thick fogs, the humidity of the soil, and the bad quality of the water.

A mud volcano. There is a volcano in the island of Taman, about 27 miles east from the fortress of that name, called Coocoobo by the Tartars, and Prekla, signifying hell, by the Tchernomorski, the present inhabitants of the country. Its eruptions, though accompanied by fire and smoke, have not hitherto been followed by any appearance of lava, its disjectitions consisting of vast quantities of viscous mud.

Geology. The following short account of the geology of the Crimea, from the pen of the celebrated Pallas, is all that our limits can afford. "In a country, containing mountains of such elevation, that snow and ice remain in some spots throughout the whole year, and which also is almost insulated, one would expect, conformable with the general laws of nature, to find the three different orders of mountains: The *primitive* or granitic mountains, as the center of elevation; the *secondary* or schistose; and the *tertiary*, composed of horizontal or flat strata, mixed with petrifactions; or at least, as in Sicily, a volcanic central nucleus, having secondary and tertiary stratifications around its skirts; but in Taurida neither of these arrangements are to be found, which are observed in all other mountainous countries. Throughout the entire maritime range of the Alpine chain of Taurida, nothing is to be seen but secondary strata of the latest order or formation, all inclined to the horizon at an angle more or less approaching to 45°, and all less or more parallel to each other, and in a direction between the south-east and north-west. All the strata, therefore, are cut off or laid open in the direction of the coast, and are all distinctly seen upon the maritime steep slopes of the mountains, like the leaves in a book, or the volumes in a library." The exterior or upper strata, consist of calcareous matter of very recent formation. The highest of the mountains afford no trace either of primitive granite, or of any regular schistose deposite, but are entirely calcareous. Beneath those enormous calcareous masses, pillars of marble, trap, clay, common limestone, and schistus, appear in parallel and almost vertical veins or strata, alternating with each other, and leaning from north-west to south-east, and their precipitous elevation in some places from the sea, bespeaks a corresponding depth below the surface of the water. Among the extraneous fossils of the Crimea, the *lapis nummularius* may be mentioned, which is there very common, though rare every where else.

Population. The population of the Crimea is said to have formerly amounted to a million and a half, but it was much diminished by the wars between the Turks and Russians; and in 1793, was only estimated at 157,125. Besides great numbers of Tartars of different descriptions, it was formerly inhabited by Turks, Greeks, and Armenians, especially in the towns along the coast; but since the Russian conquest, the Turks of course have all quitted the country. Many of the Tartars also have removed with their families and flocks to the steppes or deserts of the continent; and even the Armenians are said to have mostly abandoned the country, or rather to have been constrained by the Russians to emigrate.

According to the celebrated Pallas, the Tartars of the Crimea may be divided into three classes. The first are the Nogays, the least mixed of the Mongolian race or Moguls, who devote their attention to agriculture and the rearing of cattle. A second race of Tartars occupied the steppes or plain, from the edge of the hilly country to the isthmus of Perecop, who also resembled the Moguls. The third class, inhabiting the southern vallies of the mountains, is described as a mixed race, having a distinct physiognomy, with stronger beards and lighter hair than the other two, and were entirely stationary, devoting their attention to agriculture, and especially to the cultivation of hemp and tobacco.

The young Tartars of the plain, particularly those belonging to noble and rich families, dress nearly like the Circassians and the Cossacks, the sleeves of their coats being short and open; while the old Tartar nobles, and the common people, wear close sleeves. The old men allow their beards to grow, while young people wear only whiskers. On their heads they wear high caps, and their legs are covered with half boots. The Tartar women are generally small sized, wearing drawers, or long wide trowsers, shirts open before, an open gown of silk, with long narrow ornamented sleeves, and above all a great coat with short sleeves, and a belt round the waist. They plait their hair, which is generally covered by a small cap, or by a piece of linen crossed under the chin. They paint the nails of their hands and feet red, and stain their eye-brows black. A long narrow piece of cloth hangs down behind from the top of their heads, while tresses of hair, stained of a brown red colour, hang down on their cheeks. When out of their tents, they usually cover their faces with a fine veil of white linen. Their food consists of mutton and lamb, boiled or roasted, together with eggs, milk, butter, fruits, and vegetables, and the Nogays eat horse flesh. Their ordinary drink is water, and a kind of beer called Busa. They have few manufactures, the most noted being of leather, dressed and stained like what is usually called Morocco. The principal exports of the Crimea are wheat, salt, leather, soda, butter, fish, cordage, honey, and wax; and the chief imports are stuffs of silk and of cotton.

Towns.

There are a few indifferently built towns in the Crimea, and many villages. Perecop, or Or-capi, anciently *Taphræ*, situated on the middle of the isthmus of that name, is chiefly remarkable for its military lines for the defence of the isthmus against the roaming tribes of Scythia, consisting of a rampart and ditch, now fallen to ruin. It had been originally fortified by a Spartan general, in the fourth century before our Saviour; and the defences were restored by the Emperor Justinian, in the sixth century of the Christian era. This fortification was called *Neon Teichos*, or the new wall, by the Greeks. At Perecop there are only a very few houses, inhabited by the post-master and custom-house officers, and a small barrack. The famous wall is of earth, and very high, with an immense ditch, stretching in a straight line from sea to sea, without any remains of flanking towers; and the *golden*, or royal gate, as it is called, is narrow, and too low for the passage of an English waggon. Perecop, the Russian name of this place, means the trench or fortification; and Or-Capi, the Tartar appellation, signifies the gate.

For an account of BATCHESERAI, formerly the Tartar capital, see that article.—Before the Russian conquest, almost all the merchants and shopkeepers of the Crimea were Armenians, 75,000 of whom emigrated, or rather were driven out by the Russians, and all except about 7000 perished, from cold and hunger, in the *steppes* on the west side of the Sea of Azof. Of the present inhabitants of Batcheserai, above 1100 are Jews, of the sect of *Karaïtes*, who reject the traditions of the Talmud and Targum. About three miles from this Tartar capital is Dschoufout-Kale, or the fortress of the Jews, containing 200 houses, and about 1200 inhabitants. This sect of the Jews have the most unexceptionable character, and their honesty in the Crimea is even proverbial, their promises being considered as equivalent to a bond.

After the Russian conquest, the seat of government was removed to Akmetshet, or Sympheropol, the former being the Tartar, and the latter the modern Greek name; and it is reported, that, on this occasion, Prince Potemkin tossed up with his generals for the choice of the new capital. This is a small town about 20 miles from Batcheserai, situated upon an elevated plain, almost surrounded at irregular distances by calcareous hills, and having the principal stream of the Salgir to the east. The old Tartar town consists of a few narrow unpaved streets; and the new town, built by the Russians, is composed only of a few houses, already going to ruin.

Aktiar, or Sevastopol, in the south west angle of the peninsula, or what was anciently called the Heracleotic, or Minor Chersonesus, is built in the form of an amphitheatre, at the bottom of an excellent harbour, upon a neck of land, interposed between two bays. This town is composed of parallel streets on a declivity, divided into quarters by transverse streets, and is excellently situated for trade, which is rapidly on the increase. The harbour, which was named *Ctenus* by the ancients, and is now the anchorage of the Russian fleet, extends nearly four miles inland, is only two hundred yards wide at the entrance, which is defended by two forts and several batteries, and is nine or ten fathoms deep. In the neighbourhood of Atkiar, are the ruins of the ancient city of Chersonesus, on a bay now used as a station for vessels performing quarantine. This place was called in the middle ages Sherson and Schurschi, being the *Cherson Trachea* of the ancients, and was founded by the inhabitants of Heraclea, six hundred years before the Christian era. It is also termed in ancient writers Cheroneus or Chersonesus. In the older annals of the Russians it is named Korsun, and was called Karaje-burn by the Turks. This place must be carefully distinguished from modern Cherson on the Dnieper.

To the south-east of this Heracleotic Chersonesus, is the town and bay of Balaclava, the *Portus Symbolorum* of the ancients; and to the westward is a rugged cape, named Aya-Burun, or the Sacred Promontory, on which are the ruins of an ancient temple of Diana. Mankup, a fortress of the Genoese, now in ruins, is situated on the top of a steep rock, about eight miles inland, and E.N.E. from Balaclava.

The country included within the harbour of Aktiar, or Inkerman, called anciently *Ctenus* by Strabo, and the harbour of Balaclava, the *Symbolorum Portus* of the ancients, forms the *Minor*, or *Heracleotic Chersonesus*, which is accurately described by Strabo as a portion of the *Peninsula Major*, or *Taurica Chersonesus*. In this small district stood the three cities of *New* and *Old Chersonesus*, and *Eupatorium*, the temples of Diana, the promontory of Parthenium, celebrated as the scene of the story of Iphigenia, the famous mole of Chersonesus, with numerous ramparts, tombs, canals, and other works mentioned by historians, but which are all now in ruins, and their remains hastening to be annihilated by the Russians. The most remarkable curiosity in this neighbourhood consists of the ruins and caverns of Inkerman, or city of caverns, consisting of numerous chapels, monasteries, cells, sepulchres, &c. hewn out of the solid rock.

Karasu-bazar, or the market-town on the Karasu, is a mean irregular town of about 900 houses, yet has 23 coffee-houses, and 310 shops. The inhabitants of this town still amount to 3700 individuals, young and old of both sexes, including a curious mixture of Tartars, Russians, Greeks, Italians, Armenians, and Jews. Uskut, a populous village among vineyards, not far from the south coast of the peninsula, was anciently named *Athenion*; and a few miles to the eastward, on a steep narrow ridge, are the ruins of an ancient fortress called Tshoban-kalle, or the shepherd's hut, by the Tartars.

Sudak, or Sudagh, formerly Soldadia, Sogdaia, and Sudagra, the Sidegrius of the ancients, situated on a gulf near Cara-kaia, is chiefly remarkable for its beautiful vale, abounding in vineyards, and has the ruins of a Genoese fortress on a rock near the sea. This city rose to such celebrity for its extensive commerce, that all the Greek possessions in the Crimea were denominated Sugdania at one period.

Caffa, or Kaffa, formerly a place of great importance, but now fallen to ruin, has been already described in a separate article. See Caffa.

Kertsch, Kertchy, Cherz, Kars, or Kerez, on a bay in the straits of that name, is a small walled town on a projecting point of land, a few miles from the ruins of the ancient *Panticapæum.* The natives of the Crimea still call the town of Kertsch, and the straits, Vospor, though they write the word Bospor; and all the modern Greeks uniformly pronounce the letter β as our V. This town, though not long since of considerable importance, is now reduced to extreme wretchedness and insignificance. It was the regal seat of the Bosphorian kings, and once the residence of the great Mithridates king of Pontus.

Yenikale is a small town, with a strong fortress commanding the narrowest part of the straits of the Cimmerian Bosphorus, being the *Parthenium* of the ancients. Between this and Kertsch, on the shore of a considerable bay, are the ruins of the ancient city of *Myrmecum.* About four miles from Yenikale, towards the sea of Azof, on a rocky point advancing into the sea, stood an ancient pharos or light-house, said to have been built by Mithridates, and still called by the modern Greeks *Phanari Mitridati,* or the lanthorn of Mithridates.

Taman, on a bay in the island of the same name, anciently called *Phanagoriæ Sinus,* is a fortress of some importance, near which are the ruins of the ancient city of *Phanagoria.* There are several other towns, and many villages, particularly along the southern side of the peninsula, which it is quite unnecessary to particularize.

History. The ancient *Taurica Chersonesus* was so called from its inhabitants, the Tauri or Taurici, a Sarmatian tribe. It was also called *Chersonesus Scythica,* and *Chersonesus Magna,* to distinguish it from the Heracleotic Chersonesus, or Minor. The most anciently known inhabitants were the Cimmerians, a numerous and martial tribe of the Thracians, who long continued to defend this peninsula against the Scythians; but were driven from the plain by their more powerful adversaries, about 665 years before the Christian era, and forced to take refuge in the southern hills, where they maintained their independence under the name of *Tauri,* or mountaineers. About 550 years before Christ, the Greeks began to form colonies on the southern shores of the Taurica, at which time Panticapæum was built by the Milesians, and where they long carried on a flourishing commerce, having reduced the subordinate eastern peninsula, which formed the Greek kingdom of Bosphorus. About 100 years afterwards, the Scythians were almost extirpated by the Sarmates; after which the Tauri, called also Tauro-Scythæ, extended their dominion nearly over the whole peninsula, and pressed so hard upon the Bosphorian kingdom that it submitted, 112 years before the incarnation, to Mithridates, king of Pontus, who subdued the Tauri, and reduced the whole Chersonesus under his dominion. After the ruin of Mithridates by the Romans under Pompey, the kingdom of Bosphorus seems to have subsisted, but dependent upon the Romans, till the commencement of the Christian era, in considerable power and splendour; at which period the Alani drove out the Tauri from the greater Chersonesus, and forced the Bosphorian kings to become tributary.

About 150 years afterwards, the Alani were extirpated or driven out by the Goths, during whose dominion Christianity was first introduced into the Chersonesus, in the reign of the Roman emperors Diocletian and Constantine. The Goths were obliged, in their turn, to give way to the Huns, and took refuge in the mountains, where they defended themselves under several petty kings in strong forts, which were afterwards, by a singular corruption, instead of castles of the Goths, called castles of the Jews. The descendants of the Huns took the name of Aoultziagrians, who led a wandering life in the steppes or plain country of the Crimea, and were in the sequel reduced to subjection by the Khatyares, to whom also the Goths in the mountains, and the Greek cities on the coast, became tributary.

In 840, the emperor Theophilus subjugated the Crimea, the country between the Nieper and the Don, and Kuban Tartary, placing the seat of government at Cherson or Chersonesus. The whole of this country, or at least its steppes or pastures, was occupied by the Khatyares, under the acknowledged supremacy of the Constantinopolitan empire, and from them the flat part of the peninsula had the name of Khat, or Gatyria, corrupted into Gasaria, Chazaria, and Cassaria; the mountainous part being called Gothia from the Goths, and Tsikia from a remaining tribe of the Alani.

In 880, the Khatyrians were driven out by the Kanglians, or Petschenegers. About the year 1050, they had to fly before the Komanes or Comanians, called also Uzes, Butyres, Palatstzes, or Polouzes, to whom also the remaining Goths and Greeks became tributary. About this time, the town of Sougdia or Sugdaya, now Sudack, rose to such eminence by its commerce, that all the Greek possessions in the Crimea received the appellation of Sugdania; and in 1204 refused obedience to the empire of Constantinople. Even at a much later period, when the Turks became masters of the Constantinopolitan empire, there still remained two Greek principalities in the Crimea, one called Theodor, now Inkerman; and the other named Gothia, now Mangoute.

In 1237, the Komanes were subdued by the Mongols or Tartars, after which the Crimea became a province of the western Tartar empire of Kiptschak, the people being governed by princes of the different tribes, and roamed about the plains with their flocks and herds; and now the Greeks and Goths paid tribute to the Mongols. In the beginning of this Tartar empire, a number of Tcher-casses or Circassians established themselves in the western subordinate peninsula, and Kertsch was governed by a prince of that nation, probably taking its name from that tribe.

When the Latins became masters of Constantinople, the Venetians established an important commerce with the Crimea and the island of Taman; in which they were afterwards supplanted by the Genoese, their commercial rivals, who, by permission of the Mongoles, rebuilt Caffa, the ancient Theodosia, which they made their staple, or the centre of their commerce in the Black Sea. They also reduced Sudack and Cembalo, or Portus Symbalorum, now Balaclava. At this period a lucrative trade was carried on with India and China from the Crimea, by means of caravans in two different routes. One from Cathay or northern China across the Amour, and through central Asia, by the north of the Caspian, and Astrakan to Tanna, now Azof, in which the Venetians participated along with the Genoese.

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The other was across the Caspian by way of Trebizond, Taurus, and Bagdad, to the Persian gulf, and was established at Sevastapol or Atkiar in the Crimea.

In 1441, the Crimea became an independent Tartar monarchy under its own khans of the house of Zingis or Tschinghis; but was soon reduced under subjection to the Turkish empire, by which also the Genoese were expelled from the Crimea about the close of the fifteenth century. The Turks now placed garrisons in the principal cities and fortresses of the Crimea, setting up and deposing the Tartar khans at their pleasure; and, shutting up the entrance into the Black Sea, completely ruined the commerce of the peninsula. The Crimea continued under subjection to the Turks till 1774, when the Empress Catharine II. of Russia, by the peace of Kutschuk-Kainardgi, stipulated for the independence of the Crimea under its own khans. In 1781, a civil war broke out among the Crim Tartars, in which the Russians interposed; and in 1783, Sahim Gheray, the last khan, abdicated his power, which he transferred to Russia, and this acquisition was confirmed by a treaty with the sultan in 1784, since which Taurida has continued to be a province of the Russian empire. The abdicated khan retired into Moldavia, whence he was dragged to Rhodes, where he was assassinated by the Turks in the residence of the French consul, in which he had taken refuge.

Antiquities.

Among the most remarkable antiquities of the Crimea, are the military lines constructed in different parts by its ancient Grecian colonists, to defend their possessions from the depredations of the successive Nomadic tribes, who have infested its steppes in all ages. Besides the lines of Perecop already mentioned, there are vestiges of others for the defence of the Minor Chersonesus, said to have been erected by one of the generals serving under Mithridates the Great. There are also three series of similar field works of great extent, erected by the Bosphorian kings in different ages, to defend their eastern peninsula. It would, however, occupy too much space in this work to give an account of the numerous antiquities still visible in many parts of the Crimea, and of which ample accounts will be found in the works of various travellers, and particularly in he recent travels of Edward Daniel Clarke, LL.D. Part I. chap. xviii.—xxiii. See Tooke's *View of the Russian Empire*; Reully, *Voyage en Crimée*; Pallas, *Travels in the Southern Provinces of Russia;* Lady Craven's *Journey to the Crimea;* and Clarke's *Travels in Europe, Asia, and Africa,* Part First. (KK)

CRIMES, in a legal sense, are certain acts committed in violation of the public law of the country, and punishable by courts of justice. In common usage, the word "crimes" is understood to denote those atrocious offences, which have a more direct tendency to subvert the government or constitution, or to loosen the bonds of society; while the slighter transgressions, which do not so immediately affect the security of the public, are generally comprised under the denomination of *misdemesnors* or *delicts.* The different species of crimes, which fall under the cognizance of our courts of justice, will be found explained under their respective titles. Our object, in this article, is to give a general view of the nature and division of crimes; with a few observations on criminal law, in reference more especially to the institutions of our own country.

The difference between a crime and a civil injury seems to consist principally in this: the latter is only an infringement of the private rights of individuals, considered merely as individuals; whereas the former is a violation of the public rights of the whole community, considered in its social aggregate capacity. Civil injuries, therefore, may be prosecuted and redressed at the instance of the individual injured; but the prosecution of crimes belongs to the community, or to the person in whom the right of the community is vested. By the Roman law, the more atrocious crimes might be prosecuted by any individual member of the community; with us, all crimes are prosecuted at the instance of his majesty, through the medium of the law-officers of the crown. This distinctive character of crimes seems to be but imperfectly understood in the earlier stages of society; all offences being considered rather with a view to the immediate injury done and suffered, than to their consequences in regard to the public security. By the ancient Saxon laws, *weregilds* were allowed to compensate the crime of homicide, according to the degree of the person slain, (see APPEAL); and in England, until the reign of Henry VIII. the crime of murder was within the benefit of clergy.

Crimes.

Crimes may be divided generally into offences against the law of nature, *mala in se;* and offences against the laws of the community, *mala prohibita.* The former are clearly pointed out, and pretty universally acknowledged, by every people who have made any advances towards civilization; the latter are created by positive enactment, and depend, in a considerable degree, upon the particular genius, habits, and customs, of each country. Montesquieu divides crimes into four species. The first comprehends offences against religion; the second, offences against morals; the third includes offences against the public tranquillity; and the fourth, offences against the public safety. In the modern French criminal code, offences are classed according to their degrees of enormity. Offences of the first, or lowest class, are called *contraventions;* those of the second *delits;* and those of the highest class are denominated *crimes.* Each of those classes of offences is tried before a particular order of tribunals, and has a particular species of punishments annexed to it. With reference to the penal laws of England and Scotland, crimes may be divided into offences against God and religion, (atheism, heresy, witchcraft, &c.); offences against the government and state, (treason, sedition, &c.); offences against the public peace; offences against public trade; against the public police; against the persons of individuals; against private property. We shall afterwards, however, have occasion to shew, that these different species of crimes are not always very strictly defined; nor the punishments attached to them appropriated with sound legislative discrimination.

It is essential to the nature of a crime, that there be an intention on the part of the actor to commit it; for an involuntary act can neither lay claim to merit, nor induce guilt. Hence, if a person commit an unlawful act by chance, through ignorance or mistake, or by compulsion and unavoidable necessity, it is no crime, because there is no malicious intention. Hence, too, infants and idiots, or lunatics, are considered incapable of committing crimes; because, from the defect of understanding, they are held to be *incapaces doli.* By the civil law, minors under the age of ten and an half were not punishable for any crime; from ten and an half to fourteen they were punishable, if found to be *doli capaces,* capable of mischief; but with many mitigations, and not with the utmost rigour of the law.

From the age of fourteen, minors were liable to be punished even capitally. By the new criminal code of France, if the accused is under the age of sixteen, the judge is to call upon the jury to determine, whether it appears, from the circumstances of the case, that the prisoner acted with discernment. In the laws of England and Scotland, the precise age at which one becomes capable of malicious intentions is not fixed by any statute, but is left to the determination of the court and the jury, in each particular case. Under seven years of age, indeed, an infant cannot be guilty of felony; but at eight he may. A child under fourteen is presumed to be *doli incapax;* yet if it appear to the court that he was *doli capax,* and could discern between good and evil, he may be convicted, and suffer death. Where the guilt of the crime committed by the pupil arises chiefly from statute, so that its criminal nature is not so obvious, he ought not to be punished *nisi malitia suppleat ætatem,* unless he appear to have a degree of sagacity and judgment above his years; but where the deformity of the criminal act is discoverable by natural light, the pupil, if he be *proximus pubertati,* may be more easily presumed capable of committing it. In the annals of the criminal law of England, there are instances of minors being tried, condemned, and capitally punished, at the age of eight, nine, and ten years.

With regard to idiots, or lunatics, they are not chargeable for their own criminal acts, if committed when under the influence of these incapacities. But smaller degrees of fatuity or furiosity, which only darken reason without totally obscuring it, do not afford a total defence, but may operate in mitigation of punishment. If there be any doubt whether the party be *compos* or not, this fact shall be tried by a jury; and if he be so found, a total idiocy, or absolute insanity, excuses from the guilt; but if the insanity recur at certain periods, and the crime be committed during a lucid interval of understanding, the lunatic shall be answerable, as if he had no such deficiency. According to the English law, if a man in his sound memory commits a capital offence, and becomes insane during any stage of the trial, the proceedings shall be stayed, because the prisoner is then incapable of conducting his defence. On the subject of insanity, as a matter of defence against a criminal charge, and especially of crimes committed under the influence of a particular delusion, the reader will find a most profound and ingenious argument in Lord Erskine's speech for Hadfield.

The two great objects of all criminal legislation, are, in the first place, the punishment, and, in the second place, the prevention of crimes. The enormity of crimes being estimated according to the injury done to society, an ingenious writer on criminal law has suggested the possibility of forming a scale of crimes, with a corresponding scale of proportionate punishments; beginning with those which immediately tend to the dissolution of society, and ending with such as do the smallest possible injury to individuals. This idea is, perhaps, rather too refined; yet a wise legislator will endeavour to effectuate as near an approximation as possible to the general theory, by marking the principal divisions, and adhering to the order, at least so far as not to assign the highest penalties to offences of an inferior class. Upon the due distribution of adequate punishments, indeed, must the perfection of every criminal code depend. The right of inflicting capital punishments (although drawn into doubt by some writers of ability,) appears to flow directly from the principles of natural justice, and from the right of every community to protect the lives and properties of its citizens from ruffian violence. Capital punishments, however, ought not to be unnecessarily multiplied, by extending them to these offences, which do not seem to call for the *ultimum supplicium.* To shed the blood of our fellow creature, a very learned author observes, is a matter that requires the greatest deliberation, and the fullest conviction of our own authority; for life is the immediate gift of God to man, which neither he can resign, nor can it be taken from him, unless by the command or permission of him who gave it, either expressly revealed, or collected from the laws of nature or society, by clear and indisputable demonstration. It ought to be remembered, too, that of all punishments inflicted by human laws, that of death is the one by which the ends of justice are most imperfectly attained.

The principles which ought to regulate the enactment of penal statutes do not appear to have been sufficiently attended to in the criminal jurisprudence of England; and the frequency of capital punishment inflicted upon crimes very different in their nature and degrees of atrocity, has been mentioned as a subject of serious regret by many judicious writers. It is scarcely credible that, in the eighteenth century, it should have been made a capital felony to break down the mound of a fish-pond, whereby any fish shall escape; or to cut down a cherry-tree in an orchard: (Statute 9 Geo. I. c. 22. and 31 Geo. II. c. 42.) The sanguinary act of Queen Elizabeth, which made it a capital offence for any person above the age of 14 to associate for a month with gypsies, was executed in the reign of Charles I. and Lord Hale mentions 13 persons having, in his time, suffered death upon it at one assize. The writ *de hæretico comburendo,* one of the most arbitrary and oppressive laws that ever disgraced the criminal code of any country, was put in execution upon two Anabaptists in the seventeenth of Elizabeth, and upon the Arians in the ninth of James I.; nor was it totally abolished until the 29th Car. II. c. 9. Sir John Fortescue tells us, that in his day (in the reign of Henry VI.) more persons were executed in England for robberies in one year, than in France in seven; and Holinshed states, that no less than 72,000 persons died by the hands of the executioner, during the reign of Henry VIII. being at the rate of 2000 every year. It is surely most just and expedient, and necessary to the welfare and happiness of society, that some regard should be had to the nature and magnitude of the crime, in fixing the degree of punishment to be attached to its commission. Yet, by the criminal laws of England, to steal a handkerchief or other trifle, above the value of twelvepence, from one's person privately; to steal privately in a shop, goods to the value of five shillings, or in a dwelling-house, or on board a vessel in a navigable river, property of the value of forty shillings, are capital felonies, and consequently punishable in the same degree as murder, or any of the more atrocious crimes. It is a melancholy truth, Sir William Blackstone observes in his time, that among the variety of actions which men are daily liable to commit, no less than 160 have been declared, by act of parliament, to be felonies without benefit of clergy; or, in other words, to be worthy of instant death. This is surely extending the right of inflicting capital punishments much farther than is warranted by any principle of justice or expediency. The author last quoted maintains, that it is absurd and impolitic to apply the same punishment to crimes of different malignity. A multitude of sanguinary laws (besides the doubt that may be entertained concerning the right of making them) do likewise prove a manifest defect, either in the wisdom of the legislative, or the strength of the executive power. It is a kind of quackery in government, and argues a want of solid skill, to apply the same universal remedy, the *ultimum supplicium*, to every case of difficulty. It is, it must be owned, much *easier* to extirpate than to amend mankind; yet that magistrate must be esteemed both a weak and a cruel surgeon, who cuts off every limb which through ignorance or indolence he will not attempt to cure.

The disproportionate nature of the punishment attached by our penal laws to the commission of certain offences, appears to be indirectly admitted by the mode in which some of the criminal statutes are enforced. From the Tables kept by Sir Stephen Janssen, and published by Mr Howard, it appears that, in the seven years ending with 1756, there were convicted capitally in London and Middlesex, 428 persons, of whom about three-fourths, or 306, were executed; that, from 1756 to 1764, 236 were convicted, and 139, or above one half, executed; from 1764 to 1772, 457 convicted, and 233, or little more than an half, executed. During the interval between 1772 and 1802, the accounts have not been published; but from 1802 to 1808, the returns, printed by the secretary of state's office, afford very accurate information. In 1802, there were 97 convicted, and 10 executed, being nearly one-tenth; and the average yearly number of convictions for the whole seven succeeding years being about 75, the average number of executions was about 9½, or somewhat more than one-eight. From this statement it will be observed, that, at the commencement of the present reign, there were more executions than pardons of persons capitally convicted; whereas, of late, there have been about seven times as many pardoned as executed. From Janssen's Tables it likewise appears, that, in the period between 1749 and 1771, there were convicted for shop-lifting and similar offences, 240 persons, of whom 109 were executed. The convictions for the seven years ending with 1809, do not appear in the returns published by the secretary of state; but these returns show, that, during that period, 1872 persons were committed to Newgate, for privately stealing in shops and dwelling-houses, and that of these only *one* was executed.

There are some who attempt to justify this discrepancy between the letter and the execution of our criminal laws, on the ground, that, while the severe denunciations of the law itself operate as a terror to evil doers, it is expedient that the execution of it, in each instance, should be left to the discretion of the judge. The obvious answer to this proposition, however, readily occurs; namely, that such a system is directly contrary to every just principle of criminal legislation; that it tends to confound all proper distinction in crimes, and vests in the judges, without any adequate responsibility, a most awful discretionary power, in regard to the punishment of offences, which the legislature only ought to have the right of exercising. Terror itself, without regard to the dictates of justice and expediency, is ever a wretched principle of government or legislation; and in the enactment of laws, as little as possible should be left to uncertainty, or chance. Such a system, too, as that we have been contemplating, generally defeats its own ends; and it were easy to enumerate a multitude of evil consequences, which may, and actually do, result from such a method of dispensing criminal justice. The excessive severity of laws, says Montesquieu, hinders their execution: when the punishment surpasses all measure, the public will frequently, out of humanity, prefer impunity to it. The injured, through compassion, will often forbear to prosecute; juries, through compassion, will sometimes forget their oaths, and either acquit the guilty, or mitigate the nature of the offence; and judges, through compassion, will respite one half of the convicts, and recommend them to the royal mercy. In short, the very object of all laws, viz. that of having a clear, fixed, and known rule of conduct, is placed entirely out of view; the connection between the crime and the punishment, in each instance, is utterly lost; and no man is distinctly aware of the consequences that may attend his actions.

Beccaria justly observes, that crimes are more effectually prevented by the *certainty*, than by the *severity* of punishments. If it were possible, says Sir Samuel Romilly, that punishment, as the consequence of guilt, could be reduced to an absolute certainty, a very slight penalty would be sufficient to prevent almost every species of crime, except those which arise from sudden gusts of ungovernable passion. If the restoration of the property stolen, and only a few weeks, or even a few days imprisonment, were the *unavoidable* consequences of theft, no theft would ever be committed. No man would steal what he was sure that he could not keep; no man would, by a voluntary act, deprive himself of his liberty, though but for a few days. It is the desire of a supposed good which is the incentive to every crime. No crime, therefore, could exist, if it were infallibly certain, that not good, but evil must follow, as an unavoidable consequence to the person who committed it. This absolute certainty, however, is unattainable, where facts are to be ascertained by human testimony, and questions are to be decided by human judgments. All that can be done is, by a vigilant police, by rational rules of evidence, by clear laws, and by punishments proportioned to the guilt of the offender, to approach as nearly to that certainty as human imperfection will admit. By the system of enacting severe laws for the punishment of inferior offences, and leaving them to be executed, in each instance, at the discretion of the judge, these sound principles are completely violated: there is no certainty in the law; and the consequences that may ensue to the perpetrator of each criminal act resolve into a mere calculation of chances.

Let it be supposed,—and the case we are going to state is by no means a mere speculative hypothesis,—that two individuals are tried for the same offence before two different judges, who entertain different opinions, either in regard to the administration of the law, or the enormity of the crime; the one individual is acquitted, or pardoned after conviction; the other is condemned and executed. What must be the feelings of the public upon such an occasion! and what must their ideas be with respect to the nature and administration of the criminal law! Again; a person, under the present system, may be put upon his trial for a crime, and convicted upon a charge quite different from that preferred in the indictment, and enquired into by the court. The culprit is accused of having stolen to the amount of five shillings in a shop; and it is possible that nothing beyond this charge may come before the court which is to try it. But it is also very possible that other matter may arise out of the judicial investigation; and that this incidental matter may be so important in its influence upon the ultimate result of the trial, as nearly to supersede the original subject of enquiry. The prisoner may turn out to be a person of abandoned character, generally; he may prove to have been frequently tried before for a similar offence; he may have attempted to defend himself by suborning perjured evidence. These circumstances decide the sentence; and the prisoner is condemned to suffer death, not evidently because the law makes the crime charged a capital felony, but because he has been found, or supposed, to be guilty of that for which he never was tried, and which no law ever made capital,—of having a bad character, which is not punishable at all,—or of suborning perjury, which is punishable as a misdemesnor.

All these evils, and many more, must necessarily arise from a system of criminal jurisprudence, which is not regulated according to fixed and known principles; and in which the penal enactments are left to an uncertain and arbitrary execution. For these reasons, it were certainly most desirable, that the English penal statutes should be submitted to a thorough revision; that due regard should be paid to the classification of crimes, and the distribution of punishments; and that as little uncertainty as possible should be allowed in the execution of the laws. Much credit is due to the humane exertions of that distinguished lawyer, Sir Samuel Romilly, in this department of legislation; and it is to be hoped, that these exertions may be ultimately crowned with all the success which they merit. To conclude with the words of Sir William Blackstone: "In proportion to the importance of the criminal law, ought also to be the care and attention of the legislature in properly forming and enforcing it. It should be founded upon principles that are permanent, uniform, and universal; and always conformable to the dictates of truth and justice, the feelings of humanity, and the indelible rights of mankind." See Blackstone's *Comment.* b. iv. ch. 1. and 2.; Montesquieu, liv. xii.; Beccaria, *Essay on Crimes and Punishments;* Jeremy Bentham, *Traités de Legislation Civile et Penale, &c.* par Dumont; Sir Samuel Romilly, *Observations on the Criminal Law of England, as it relates to capital punishments, and on the mode in which it is administered*; *Edinburgh Review*, vol. xviii.; and M. Dumont, *Sur les peines et les recompenses.* (*z*)

CRIMSON. See DYEING.

CRINODENDRUM, a genus of plants of the class Monadelphia, and order Decandria. See BOTANY, page 267.

CRINUM, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 185.

CRISTARIA, a genus of plants of the class Monadelphia, and order Polyandria. See BOTANY, p. 272.

CRITHMUM, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 165.

CRITICISM, in its most extended sense, is the act of judging, and of expressing our judgment on the excellencies or defects of any object to which our attention is directed. In this sense, we speak of a critic in war, a critic in wine, and even of a critic in natural beauty. But as the conceptions of others, and the manner in which they are communicated, by engaging the greatest and most interesting portion of our thoughts, present the most frequent opportunities for the exercise of this faculty, the term, from its constant recurrence in a limited sense, has been employed, when no other limitation is expressed, to signify the act of pronouncing judgment in the fine arts, and particularly in the various species of literary composition. As soon as men began to impart their ideas for the purpose of instruction or amusement, criticism would also begin. The mind is naturally jealous of a teacher, in whom there must always be some pretension to superiority, and is disposed to ascertain his title to that character, by examining the value of his information. Though pleasure alone be the object of a communication, we are equally jealous of a superior in the power of pleasing; nor is there wanting in the most uneducated understanding, philosophy enough to prompt an investigation into the causes to which the success or failure of the attempt may be ascribed. Even in conversation, we are gratified to find any extraordinary claim on our attention, sifted by one who is qualified for the task, and to whom a consciousness of the qualification is generally a sufficient incitement. Identity of interest rendering us his tacit allies, we encourage him to put forth his power against the challenger for the prevention of an unmerited triumph; and as literary composition is little else than conversation on a larger scale, the process of feeling will be similar in those to whom it is addressed. Such, indeed, is human nature, as in all periods to verify the adage, *nunquam eminentia invidia caret;* or to make

—— Each little wit
Chuckle, to see the greater hit;

and therefore the more obvious the excellence of any effort, and the increase of reputation which it produced, the more certainly would some of those, who feel themselves depressed when others are exalted, dispute the superiority of its author, or seize the opportunity to claim an acknowledgment of their own, by confirming or correcting the impression which he had made. From various motives such attempts are generally favoured. Those who took delight in the original sound, welcome its repetition in the echo of the critic; and those, whose envy had exceeded their admiration, turn a ready ear to any thing by which that uneasy feeling can be alleviated. Both have the additional gratification of seeing the energies of human nature exerted; for conflicts of the understanding, like those of the body, are always interesting to spectators, who are proud of partaking the faculties of the combatants.

Criticism, therefore, naturally grew with encouragement; and after the invention of writing, which both augmented the number of authors, and offered a better opportunity of deliberately studying their merits, the number of critics was augmented in proportion. This invention, also, gave rise to a new order of critics, whose aim was more humble, though at the same time more necessary, than that of the aspiring arbiters of literary distinction. These were *verbal*, or *emendatory* critics, who laboured rather to determine exactly what an author had said, than to pronounce in what degree his sayings were to be esteemed. They confined themselves to the task of separating the spurious from the genuine ore; but to ascertain the weight and fineness of the latter, was, in the subdivision of labour, generally reserved for others. Before the discovery of printing, the errors of transcribers, and after that discovery, their repetition from the press, rendered verbal criticism a work of difficulty and importance. The requisite qualifications for its discharge were extensive learning, penetrating judgment, habitual familiarity with the turn of thought and phrase peculiar to the writer, and a nicety of idiomatic *tact*, which practice alone could confer. The exercise of these qualities, stimulated by the growing hope of approaching the object of research, could not fail to be pleasing to their possessor, if we may judge by the pleasure which we occasionally derive from their success. To see a passage of obstinate perplexity rendered intelligible, by the change of a point, or a letter, is accompanied with those emotions of surprise and satisfaction, which naturally result from the sudden recovery of what was lost, from the completion of what was defective, from the comprehension of what was obscure, and from the triumph in human ingenuity when accomplishing an arduous effect by a slight operation. Such are the emotions which, amid numerous disappointments, we have frequently experienced, from the skilful and sagacious conjectures of a Heyne, a Porson, a Toup, a Warton, or a Tyrwhit. Nearly akin to verbal is *elucidatory* criticism, which attempts to remove obscurities, by referring to some local custom or obsolete event, by quoting the phrase from some author, where the context has made it intelligible, or by employing the united force of learning and argument to establish a meaning, which others had missed. To this class of critics, as well as to the former, considerable praise is due, for the sudden light which they are sometimes able to introduce, from a remote and unexpected quarter, into the darkest passages. Both, however, are apt to become too enamoured of the arts in which they excel, and to fatigue the reader, by forgetting the precept *ne quid nimis*. The one often prolongs his experiments on words, till we nod over the crucible, where he tries to restore them from an oxydated to a metallic form; while the other displays his erudition, by accumulating explanatory quotations, till the doubtful phrase, like a sickly infant overlaid by the nurse, is lost in the crowd that is brought to its assistance. These errors are justly ridiculed by Young.

> Imperious some a classic fame demand,
> For heaping up, with a laborious hand,
> A waggon load of meanings for one word,
> While A's deposed, and B with pomp restored.
> Some for renown on scraps of learning dote,
> And think they grow immortal as they quote.
> To patchwork learned quotations are allied:
> Both strive to make our poverty our pride.

For the justice of these remarks, we may appeal to the commentators of Holland and Germany, countries peculiarly fertile in these tedious interpreters, who, however serviceable, are no more to be compared to those who investigate the genius and spirit of an author, than the workman who repairs a rotten plank, to the scientific teacher of the art of navigation. Into criticism of the first kind few have patience to enter; but all are disposed to listen to the last. All are desirous to see their judgment of a literary work confirmed by others, in whose wisdom they confide; or to be guided by the same authority where they have had no opportunity of judging for themselves, to studies which may be profitable or pleasing. From experience, however, they would soon discover that the sentence varied with the temper, the talent, and the prejudices of the judge; and it therefore became desirable to establish a system of general and immutable rules, to which both the writer and the critic might appeal. This gave rise to what may be called the Philosophy of Criticism, or the Legislation of Taste, of which Aristotle, in his Poetics, offered an early and splendid example. Applying to poetry that faculty of generalisation, which he possessed in singular perfection, and which on all subjects he delighted to exercise, he drew from the nature and objects of the art, and also from experience of its practical effects, a code of rules to serve as its future standard. Specimens in the same department of criticism were afterwards produced by Longinus, Dionysius, and Demetrius Phalareus; by Cicero, Horace, and Quintilian; and, in modern times, the general principles of criticism have become a regular branch of academical education. Critics of this speculative character maintain more dignity than those who descend into the *arena*, and grapple with individual writers; in the same manner as the didactic politician is regarded with more general respect than one who engages, as a partisan, in the official details of contemporary government. It may be doubted, however, if the former command equal interest with those who personally " mingle in the mortal fray," and who enliven their strictures with that dramatic animation in which all are formed to delight. Polemical criticism, therefore, by its exemption from the more dignified dulness of abstract maxims, is often of greater practical benefit; as precepts, casually thrown off in the ardour of dispute, and embodied in examples which force attention by their novelty, make a deeper impression on the mind, than those which are calmly pronounced *ex cathedra*, and unassociated with any personal circumstance, to assist the memory in recalling them when required. To this may, in a great degree, be ascribed the justice of the following remark by the French Academy: " Les connoissances qui sont estimées les plus belles, sont presque toutes sorties de la contention des esprits; et il est souvent arrivé que par cette heureuse violence on a tiré la verité du fond des abimes, et que l'on a forcé le temps d'en avancer la production. Il servit superflu de faire une longue deduction des innocentes et profitables querelles qu'on a vu naitre dans tout le cercle des sciences entre ces rares hommes de l'antiquité. Il suffira de dire que parmi les modernes il s'en est emu de tres favorables pour les lettres, et que la poesie servit aujourdui bien moins parfaite qu'elle n'est sans les contestations qui se sont formées sur les ouvrages des plus celebres auteurs des derniers temps."

Criticism being thus, not only a natural, but a popular exercise of the mind, authors in all ages have been sure of encountering this intellectual reaction. Aristarchus and Zoilus, among the Greeks, have, from their severity, become generic names for the whole class of literary censors. Bavius and Mævius, among the Romans, damned themselves to immortal fame, by provoking a contemptuous notice from Virgil, and a lively imprecation from Horace; and we are told by one of the first and one of the last of the Latin classics, (by Terence and by Martial,) who dwells on the *dominæ fastidia Romæ*, that neither of them escaped the reprehension of their contemporaries. After the restoration of letters, critics were not the slowest to reappear on the scene; but, for a while, their labours were circumscribed, by the expence which they incurred, from the necessity of offering them to the world in separate publications. In the 17th century, this inconvenience was removed by the lucky project of a pamphlet, which should appear at stated intervals, and which all the critics of the day should be permitted, and even invited, to fill with their lucubrations. By this contrivance, the scale of intellectual warfare was extended from unconnected single combats, to a field where a whole squadron of the critical force might array themselves against an equal number of candidates for renown. Authors, too, could thus be brough to trial, by a sort of periodical *assize*, or *gaol delivery* of literature, (if the expression be allowable) with the greatest economy and expedition; and many scraps of critical augury were secured from the fate of the Sibyl's leaves, or becoming, by their disconnection, *rapidis ludibria ventis.*

France led the way, in her *Journal de Sçavans,* which began to be published by Salle in 1665, and was followed, in 1684, by the *Nouvelles de la Republic des Lettres* of Bayle, and, in 1686, by the *Bibliotheque Universelle et Historique* of Le Clerc. Early in the 18th century, the plan was adopted by England, where the following works successively appeared. The *Memoirs of Literature,* after eight volumes had been completed, ended in 1722: The *New Memoirs of Literature* began in 1725, making 6 vols.: *The Present State of the Republic of Letters* in 1728, making 18 vols.: The *Historia Literaria* in 1730, making 4 vols.: *The History of the Works of the Learned* in 1737, making 13 vols.: The *Literary Journal* (published at Dublin) in 1744, making 5 vols. Most of the preceding works professed to give an abstract, rather than a character, of contemporary publications. But, in 1749, the *Monthly Review,* projected by Griffiths,* a bookseller, who conducted it for more than half a century, succeeded in accommodating the public taste with that form of criticism which it still prefers; and the popularity of this work led Dr Smollet, in 1755, to establish the *Critical Review,* on a plan exactly similar. These two journals continue their regular appearance at the present day, while numerous competitors have either perished in the infancy of their attempts, or faintly protract a precarious existence. Still, however, there was room for bolder adventurers in critical speculation. The old *regime* of literary censorship had, from sanguine reliance on a stability so long enjoyed, and indolent dislike to innovation or reform, become feeble and corrupt. Those in its administration employed, from cupidity, substitutes of cheap and inferior talents, who verified the remark of Rousseau, *qu'il est trop difficile de penser noblement, quand on ne pense que pour vivre;* while the professional interests of the administrators introduced a system of favouritism and secret influence, which deprived their government of all confidence and respect. Discipline being thus slackened in the republic of letters, some able and ambitious spirits thought matters ripe for the introduction of a *new order of things,* which they accomplished, in 1802, by instituting, in this metropolis, a critical journal, which soon threw all others into the shade, by its promise of superior independence of principle, and vigour of execution. On the first appearance of the *Edinburgh Review,* its authors shewed their acquaintance with the propensities of human nature, and their readiness to take advantage of its infirmities, and of the particular temper of the present age. They might almost be supposed to have borrowed a hint from the new system of war, which they had seen so successful. Though they did not decline the occasional aid of veterans, yet their "sacred cohort" was composed of youthful adventurers, whose qualifications were known to each other, but not to the public, and whose reputation and rank were yet to be acquired by that inventive enterprise from which they anticipated more splendid effects than from the caution of practised tacticians. They first created a deep impression of their power, by an exhibition of talent far beyond the standard of the old tribunals, and by assigning each article to a person who, from the peculiar direction of his studies, could not be chargeable, like the *all-work* critics, with knowing less of the subject than the author whom he undertook to correct. They next made it evident, by an early display of vituperative ingenuity, of which the consciousness generally secures the exercise, that the power they possessed would not be tamely or tremblingly exerted. Aware of the fashionable taste for raillery and ridicule, with which even the senate is so much infected, that we may say, like Juvenal, *Natio comœda est,* they shewed their purpose to indulge it, "and sharply smile prevailing folly dead:" and thus made their readers sure, that, whatever might be the substance of the repast to which they were invited, its seasoning would be of the keenest pungency. At their outset, too, they took a tone of higher authority than critics of the longest standing had dared to arrogate, and seemed to imitate the celebrated Busby, when he told his royal visitor, as an apology for remaining covered, that "in his own school no one must appear greater than he." They knew that lofty pretensions, though they may not gain all that is demanded, seldom fail, from the timidity or indolence of mankind, to obtain more than would have been granted without them; and, notwithstanding the amplitude of their means, they did not disdain the aid of something akin to what was called in Johnson his *bow-wow* manner, nor of those intimidating insinuations of their own might, and contempt for their destined object of attack, which a contemporary conqueror had found so efficient an accession to means equally ample in a different department. By this combination of ability and address, and by the diligence with which both were sustained, the new oligarchs have risen to a dominion which was never yielded to others, and continue to be regarded as the *Dii majorum gentium* of the critical theogony. Such is the popularity of their work, notwithstanding the frequent forfeiture of its original professions, that 10,000 copies are periodically circulated; the faults of its reasonings being forgot in the splendour of its illustrations, and the occasional immolation of an innocent victim pardoned for the pleasure derived from the occurrences of the chace. An attempt at partition of empire has recently been made by a London journal, (the *Quarterly Review;*) but though a respectable force has been embodied for the enterprise, the predominance still remains with our countrymen.

After this slight sketch of the past and present state of criticism, we shall subjoin a few remarks on its advantages and disadvantages. The most important of the former ought to be an improvement of authors in the matter and style of composition. If a scholar is excited to diligence and accuracy, by the certainty that his exercise will be severely scrutinized by the master; if an accountant is guarded from error, by knowing that his calculations will be checked by a board of auditors; the same effect should be produced on writers, who are aware that their work will be stopt at its outset, and examined with rigorous jealousy, before it re-

* The history of this father of the modern system of reviewing is somewhat singular. He had been bred a watchmaker, but came to London as a bookseller, and soon after began his review. Having purchased the *Memoirs of a Woman of Pleasure* from the author, who was a Mr Cleland, (son to Col. Cleland, the *Spectator's* Will Honeycomb.) Griffiths praised the work in his review, to promote the sale. For this publication he was prosecuted, but escaped conviction, by anticipating the search of the police officers, and removing all his copies of the book at a back door of his warehouse. He afterwards failed, and the review was sold to Collins, a bookseller in Salisbury. Griffiths, however, continued manager, and recovered the property in 1780. He afterwards became rich. The short characters of books in his monthly catalogue were written by Mrs Griffiths.

ceive the marketable stamp from the assay-masters of the literary corporation. The prospect of such a scrutiny should, therefore, deter the timid, and make the forward cautious, and should thus diminish the number of flimsy productions which tend to encourage sciolism, and corrupt or retard the progress of the public taste. On this subject we may borrow the elegant language of the French Academy: "Si la censure demeuroit dans ces bornes, on pourroit dire qu'elle ne seroit pas moins utile dans la republique des lettres, qu'elle le fut autrefois dans celle de Rome, et qu'elle ne feroit pas moins de bons ecrivains dans l'une, qu'elle a fait de bons citoyens dans l'autre. Car c'est une verité reconnue que la louange a moins de force pour nous faire avancer dans le chemin de la vertu, que le blame pour nous retirer de celui du vice; il y a beaucoup de personnes qui ne se laissent point emporter a l'ambition, mais il y en a peu qui ne craignent de tomber dans la honte. Ces avis, si utiles en toutes choses le sont principalement pour les productions de l'esprit, qui ne sauroit assembler sans secours tant de diverses beautés dont se forme cette beauté universelle qui doit plaire à tout le monde."

A second advantage should be, the improvement and propagation of critical acuteness in the public mind. As periodical newspapers diffuse a knowledge of political science, and a perspicuity in noticing the misconduct of our rulers, periodical reviews, which are calculated for popular instruction, by insinuating their lessons in the *concrete*, rather than in the *abstract* form, should quicken the general sensibility to literary excellence, and render us, like the Athenians, a nation of critics. A third advantage should be, the improvement of the critics themselves. It has been often observed, that to teach is the speediest way to learn. Those who employ themselves in the detection of literary faults, should acquire, by practice, a habitual delicacy in perceiving, and promptness in avoiding them; so that their own writings ought to furnish not only rules, but models of composition, and "be themselves the excellence they draw."

If these have not been the effects of criticism, it must be owing to certain imperfections in its execution, which appear so incapable of remedy, that they may be numbered among its permanent disadvantages. Critics in general have a tendency to censure, rather than to commend. They wish to exalt themselves above their author, as an apology for assuming the office of his judge. As this cannot be accomplished by the mere acknowledgment of beauties, in the production of which they had no concern, it is attempted, by an enumeration of errors, and by claiming credit for an excess of ability, proportioned to that of which the writer has been deprived, by an original exertion of their own. Critics, too, are seldom actuated by disinterested zeal for reform in literature, nor will they sacrifice an occasion of gaining fame for themselves, to the tardy recompence for which every good teacher should wait, in the gradual improvement of his disciples. Under the influence of such motives, they are too frequently seduced to employ a microscopic eye, in eliciting or exaggerating blemishes; and if they happen likewise to excel in satirical asperity, or scornful invective, they cannot deny themselves the exhibition of their specific excellence, or an intemperate and unnecessary exercise of the scourge, merely to display their dexterity in laceration. Genius, therefore, with its usual accompaniments of pride and sensibility, will often suppress its exertions from a fear of mockery or insult, which no subsequent applause can repair; while phlegmatic dulness, which does not feel, and forward vanity, which does not fear rebuke, will continue as liberal of their communications as before; and the public must console itself with the brilliant effusions of the critic, for the double injury which they create, by becoming the involuntary cause, "That Maro will not write, and Mævius will." It is obvious, too, that where general interest is thus sacrificed to the individual vanity of the critic, he will rather deprave than refine the popular taste and his own, by creating in both a preference of impertinent smartness to liberality and candour. Philosophical or didactic criticism should produce no such unfortunate results; but should be as advantageous to literature, as to the improvement and embellishment of the mind of the critic. On the one hand, every able attempt of this description advances the inductive process, and brings us a step nearer to success, in fixing a standard of taste, and in establishing practical rules for the liberal arts, by ascertaining the qualities which give pleasure to the greatest number of cultivated understandings. On the other hand, the love and the study of these arts seldom fail to give an interesting elegance and attractive amenity to the character of the student. To excite pleasing emotions in others, is the most general expression of the object, and to be natural, graceful, consistent, and correct, the most general expression of the rules, prescribed to an artist; and the pursuit of such an end, by such means, must have a powerful tendency to influence the habitual disposition, and to impart an agreeable seasoning to the sentiments and conduct of those who engage in it. It affects even the moral feelings, for he who is most enamoured of grace, propriety, and truth in imitations of nature, can scarcely be insensible to their charms in the regulation of life.

On this point we have the concurrence of Quintilian. "*Adde quod ne studio quidem operis pulcherrimi vacare mens, nisi omnibus vitiis libera, potest: primum quod in eodem pectore nullum est honestorum turpiumque consortium: et cogitare optima simul ac deterrima non magis est unius animi quam ejusdem hominis bonum esse ac malum.*" Exceptions, we know, may be stated, but not in such a proportion as to infringe the rule; and therefore it is generally found that enlightened theorists in the polite arts, become the most captivating members, the *dulcia decora* of society, while the polemical critic, though a sturdy combatant whom it may be a boast to have seen, exhibits nothing of that "soft green of the soul" on which it is pleasing to dwell. Of this we may partly be convinced, by comparing the contumelious and irascible beings which the names of a Salmasius, a Burman, or a Warburton, present to the imagination, with the mild, persuasive, and paternal monitors, whom we contemplate in a Longinus, a Quintilian, a Bossu, or a Blair. We may add, that of all the branches of a liberal education, none are so delightful, as those of which the object is our introduction to the pleasures of taste. Such studies are accompanied by no less interest and gratification in their elementary details, than in their result; and when, at an after period, we look back to our academical instructors, a double portion of grateful reverence is felt for him, who had been most successful in unveiling to us the genuine fountains of the beautiful and sublime. We regard him as one who had enlivened and multiplied our enjoyments, and who, as if by couching the intellectual eye, had awakened us to the exercise of a new sense, and to the perception of qualities in matter and mind which had hitherto been occult. To others we seem indebted

Croatia. only for an addition to our knowledge, but to him for an addition to our nature.

In general criticism, the evil to be chiefly avoided is excessive refinement, and fastidious delicacy. The mind may become so captivated with an ideal model of excellence, as to forget that perfection is unattainable in practice, and to be less delighted with a multitude of beauties, than disgusted by a few defects in a production of genius. Thus the student, as he advances in his pursuit, recedes from its object, and instead of providing for himself a store of pleasures unknown to coarser minds, he will only sharpen his sensibility to petty vexations, increase the number of his disappointments, and improve himself in that sinister ingenuity, which extracts from every object all the pain which it is capable to produce. When the whole force of the mind is expended on the cultivation of taste, to the neglect of its other faculties, this wayward squeamishness may be innocently, though injudiciously, created; but it is far oftener the effect of finical affectation, and fantastic horror at the vulgarity of being too easily pleased. In the last case, it is deserving only of contempt; in the former, it should be counteracted, by habitually conforming our expectations to the scene in which we have been destined to act, and by cultivating that benevolent temper, which is prone to encourage every attempt to please, especially by exertions of the mind, and which, with a liberal allowance for human imperfection, is more apt to be surprised that an artist has done so much, than offended that he has not done more. When from pride of understanding, we suffer our discovery of faults, either in moral or intellectual action, to beget an indiscriminate disgust with the agent, and to prohibit our enjoyment and encouragement of his more successful attempts, the acumen by which the detection is made, will be more prejudicial than advantageous to the interests of literature, and the comforts of society. (w)

CROATIA, a country of Europe, constituting formerly a part of the ancient Illyricum, but now dependent on the crown of Hungary, is bounded on the east by Sclavonia and Bosnia; on the south by Dalmatia, Morlachia, and the Adriatic; by Carniola and Stiria on the west; and is separated from Hungary on the north by the river Drave, which is very rapid and often impassable. It lies between 44° 5′ 48″. and 46° 25′ 50″ North Lat. and 32° 0′ 12″, and 35° 5′ 30″ East Long. of Ferro; and its greatest length from north to south is about 180 miles, and from east to west its greatest breadth 110, presenting a surface of above 10,700 square miles. Formerly, however, the boundaries of Croatia were more contracted. The counties of Warasdin, Kreutz, part of Agram; the military district of Warasdin, and the frontiers called *Banalgranze*, were only incorporated with it in the reigns of Ferdinand, and Leopold I.; and the maritime districts constituted, formerly, a part of Dalmatia.

Extent.

Political division.

The present political division of Croatia consists in the civil or provincial department; and the military department. In the former are comprehended the maritime districts, known under the name of *Littoral;* and the three counties of Agram, Warasdin, and Kreutz. The military department comprehends,

1. The military district of Carlstadt, which has four regiments, viz.

The district of the regiment of Licca,
. . . . of Ottochacz,
. . . . of Ogulin,
. . . . of Szluin.

2. The military boundary of the frontiers called *Banalgranze*, divided into two regiments, viz.

The district of the first regiment of the frontiers,
. . . . second do. . . . . . do.

3. The military division of Warasdin, composed also of two regiments, viz.

The district of the regiment of Kreutz,
. . . . of St George.

Mountains.

Croatia is throughout extremely mountainous, but diversified by several beautiful and fertile vallies, and some plains of considerable extent. The highest land is on the south-east; and the principal mountains extending between Carlstadt and Dalmatia, stretch towards Istria and the Adriatic. The Wellebit range is very steep, and full of frightful precipices; and equals in elevation the highest Alps, being 900 toises above the level of the sea. Its direction is chiefly along the coast of the Adriatic, and its whole extent is 80 miles. The Kapella mountains take their rise near the lake of Plitvicza, and running towards the south, almost parallel with those of Wellebet, extend nearly 90 miles. They are divided into the little and the great Kapella, the highest of which is not above 500 toises. The mountains of Plissivicza are the loftiest in Croatia. Their rugged summits are formed of perpendicular rocks, and are 925 toises above the level of the Adriatic. These mountainous ridges, which occupy almost the whole military district of Carlstadt, present on all sides a singularly rugged and frightful appearance, and form a part of the *Mons Ardius* of Strabo, to which some German authors have improperly given the name of the Dinovian Alps. Besides these, are several smaller chains; as the mountains of Merzlavodicz, which extend from 60 to 70 miles between the sea and the rivers Kulpa and Korana; the mountains of Sichelbourg, which reach from the Kulpa along the confines of Carniola as far as the Save; the mountains of Verbacs Ka-Staza; and the Kamenita Goricza. There are also several detached mountains, the most considerable of which are, the Zyr, the Bilay, the Osstra, the Debelo-Berdo, and the Bogdanich.

On the summits of the Croatian mountains are several remarkable valleys, which are so completely shut in by lofty ridges, that the rivers find no outlet but by penetrating the soil, or by forming a subterraneous passage; and when these rivers are swollen by the rains, and finding no sufficient means of escape, they inundate the whole valley, and form a temporary lake. Of these vallies the most extensive is that of Licca, which is contained by the Wellebit mountains and those of Verbacs Ka-Staza. It is sandy and barren, and a great part of it is rendered uninhabitable by the impetuosity of the winds, which rush through the passage between the mountains. The other most considerable vallies of this description are those of Korbavia, Korenicze, and Szenski-Put. Among the mountains in the northern parts are several beautiful spots, which, by their exuberant fertility, form a striking crontrast with the bleak and barren regions which surround them. Of these the principal are, the valley of Draga, between Piket and Buccuri; that of Scarigna not far from Fiume; and that of Vinodol near Ezirquenicza, so called from the number of vineyards, with which it is covered. A considerable extent of level country reaches along the shores of the Drave to the borders of Sclavonia; and between Agram and Petrinia is a large plain above fifteen miles in length, of

Croatia. which the plain of Turoposia, so famous for its privileges, forms a part.

Rivers. The principal rivers of Croatia are the Save and the Drave, the former of which has its source in the Alps of Carniola, and the other in the Tyrol; and are both navigable. The rest take their rise in the country, and empty their waters into these rivers, or lose themselves in the cavities of the mountains: except the Zermania and the Reka, which, after a short course, fall into the Adriatic. Of these the Unna and the Culpa only are navigable. The Unna rises at the foot of mount Chemernicza near Szuha, and has such an abundant supply of water, that it is navigable almost the whole length of its course. The Culpa springs from mount Szegina, and crossing Croatia from east to west, passes into the Save near Sziszeg. Such as have their springs in the mountainous regions, present at once deep and rapid torrents, which rush with impetuosity through the narrow clefts of the rocks; and some of them form magnificent cascades, particularly the Sluinchieza, which has 43 beautiful falls, setting in motion an equal number of mills. Many of these rivers, when swelled by the rains, or by the melting of the snow, overflow their banks, and spread their waters over the country. The valleys are then converted into lakes; and, the subterraneous canals being frequently choked up with mud, it is often long before the waters can force a new passage for their escape. Considerable damage is annually sustained by these inundations, particularly in the military district of Carlstadt, the country of Dubitza, and in the neighbourhood of the

Marshes. Drave; and to them must be attributed the formation of the immense marshes which are to be found in many parts of the country. The marsh near the village of Ternowacz extends over 861 acres; and that of Chemernicza, in the district of the regiment of Kreutz, covers about 10,000. There was formerly another in the same district of 8000 acres in extent, which has been completely drained by the exertions of the Archbishop of

Lakes. Agram. Of the lakes in Croatia, those of Plitzvicza, on the heights of the Little Kapella, are most deserving of notice. They are eight in number, and communicate with one another by immense cascades, which has a very beautiful and striking appearance. Two of them are surrounded by steep and rugged rocks, which render them completely inaccessible; and they can only be viewed from the top of the precipice, from which it is fearful to look so low. Notwithstanding, however, this profusion of water, and the frequent inundations to which this country is subject, it is very remarkable that the inhabitants are sometimes exposed to all the inconveniencies of severe drought. During a dry season the springs are exhausted; the beds of the torrents are empty; and water for the common purposes of life is often brought from a distance of nearly four or five leagues.

Mines. Croatia contains several valuable mines of iron, copper, and lead; but most of them are entirely neglected, and none of them are wrought with any degree of spirit; though there are immense forests in their neighbourhood and of no other use, the only mines, at present wrought, are the copper mines of Szamabor, whose annual produce is about 2000 quintals; and the iron mines of Esuber, Brod, Mrslavodicza, and Kossna; of which that of Esuber is the most considerable, and it produces only about 1000 quintals of iron annually. It is said that there were formerly mines of silver at Streberniak and near Novi, but no attempt has been made to recover them. Some gold is gathered by the peasants in the bed of the Drave, between Mahrburg and Dernje, for which they receive from the king three florins twenty-four kreutzers for every ducat weight. The quantity produced in this way amounts annually, upon an average, to from 15,000 to 18,000 ducats. Salt, blue and green vitriol, coals, and sulphur, are also found in Croatia; and quarries of beautiful marble abound in different parts of the country. All the bridges and parapet walls on the Caroline road are built of marble, and also many of the houses in Fiume, Zeng, and Porto Re.

Mineral waters. Of the mineral waters of Croatia, the most frequented are those of Jamnicza and Laszina, the one on the left, and the other on the right bank of the Culpa; and of its hot wells, that of Tœplicza, which was known to the Romans, has the highest temperature, being 46° of Reaumur. The only salt spring at present known in this country issues from a rock near the village of Szlana; and fifteen pounds of its water contains three drams of common salt.

Climate. The climate of Croatia is very unequal, and is not to be measured by its geographical position, but depends entirely upon its relative situation with respect to the Adriatic, the Alps of Carniola, or upon the elevation of the country; while, on the coast, the thermometer of Reaumur stands at 17 degrees in other places, it will scarcely exceed 8 or 9 at most. In the military district of Carlstadt, on the mountains of Wellebit, Plissivicza and Kapella, and indeed throughout the whole western division of the country, except in the vicinity of the sea, the snow generally lies for eight or nine months; and in the narrow defiles on the heights, it sometimes continues the whole year. The most prevailing winds are the north; north-east, south, and south-west. Those which blow from the continent are dry, but those which come from the sea are almost always accompanied with rain; and it is no uncommon circumstance on the coast, to have six months of wind and rain, and a severe drought the rest of the year. The north-east wind is here most piercing and violent; and during winter often rises into furious storms, which devastate the whole country.* The only spot in this district which is free from its ravages is the narrow plain of Zermania in the regiment of Licca, which, being sheltered by the mountains, enjoys a temperature equal to that of Italy, and produces all the fruits peculiar to that climate.

Soil. Though Croatia presents several beautiful and well cultivated valleys, yet it may, in general, be considered as a barren and ungrateful country. The soil partakes much of the diversity of the climate. In the mountainous regions, except in a very few spots, it is stony and perfectly sterile; and towards the sea, one sees nothing but naked rocks, despoiled of every particle of vegetable earth by the impetuosity of the winds. The lands, however, which are situated in the north and east, and are watered by the Drave, the Save, the Culpa, and the Unna, are more fertile. They are enriched by the mud which is deposited during the inundation of these rivers;

* "Il est difficile," says Hacquet, "sans l'avoir connu par sa propre experience de se figurer combien ces vents terribles du nord-est sont dangereux, particulierement sur les côtes; tantôt ils precipitent irresitiblement dans les flots de la mer les hommes, et les quadrupedes, tantot ils les jettent contre des rochers. Beaucoup de personnes perissent aussi par une grêle de gros cailloux, que l'impétuosité de l'air souleve comme des morceaux de paille. Ce vent, qu'on appelle *la bora*, est accompagné d'un froid si penetrant, qu'il devient mortel aux personnes qui en sont atteintes en pleine campagne."

Croatia.

Soil and agriculture.

and are productive in maize, rye, oats, and other kinds of grain. There are also plenty of fruit trees, particularly plums, a few vineyards, and immense forests of lofty oaks. But agriculture is here little understood, and meets with many obstructions, as well from the indolence of the peasant, and the nature of the government, as from the sterility of the soil. In the military districts, the houses, which were formerly scattered over the country, are now collected into villages, which has removed the labourers to such a distance from their lands; sometimes three or four leagues, that they take little interest in their improvement; and consequently the only appearance of regular cultivation is confined to the vicinity of the villages. The common practice of cultivation in this country is to crop for three years, and then to allow the land to lie fallow for a certain time, according to the quality of the soil. In the military district of Carlstadt, after dunging the land, they sow it the first year with maize, wheat, or barley; the second with rye, and the third with millet or oats. They then dung it anew, or turn it for several years into pasture. Many of the peasants never think of weeding their fields; of clearing them of stones, or of draining away the stagnant water. They cultivate them as long as they will produce any thing; and then leave them to lie fallow for twelve or fourteen years until they recover their strength. The produce of wheat, rye, and barley, is estimated in common years at six for one; maize at forty; buck-wheat at six; millet at twenty; and oats at four for one. Wheat and rye, however, are only cultivated on some of the baronial lands, and in the military districts. The culture of the potatoe was introduced into this country in 1780 by the soldiers, who returned from Silesia and Bohemia after the war for the succession of Bavaria; and a considerable quantity is now produced in the county of Agram. In the county of Warasdin, however, a severe law was necessary to compel the inhabitants to the cultivation of this useful root. It was promulgated in 1802, and enjoins, that every householder shall plant a certain quantity of potatoes, under the penalty of forty strokes of the cudgel. Flax and hemp are cultivated here, but they are neither abundant nor of good quality; and cotton has been attempted in Warasdin, but with very little success. Fruits are also scarce. The most common are plums, from which the Croats distil a favourite beverage called *schliwowitza*. They rear also a few cherries, apples, and pears; and near Fiume and Buccari, olives, and figs. The best fruit is produced in the valley of Dragan; but it is most abundant in the county of Kreutz, where every peasant is obliged to engraft at least twenty-five trees every year, under pain of as many strokes of the cudgel. Vines are rather plentiful in the northern and eastern districts, and afford wine of great strength and excellent flavour. The wine of Moszvina is equal to the best Burgundy; and that of Vinodol sparkles like Champagne. It is all, however, consumed in the country, and, like the Italian wines, will not keep. Mulberries are also cultivated in considerable abundance in some districts; but pulse and kitchen stuffs are almost completely neglected; and nothing is seen in their gardens but onions, garlick, and cabbage, of which they make chou-croute, a favourite dish in Croatia.

A great part of this country is covered with immense forests. The beech is the most prevailing wood on the mountains, and the oak in the plains; but there are also elms, ashes, birches, lindens, alders, poplars, pines, and firs, which might furnish an almost inexhaustible supply for ship-building. Little advantage, however, can be derived from them, on account of their distance from sea-ports, and the difficulties of conveyance.

Croatia.

Agriculture and produce.

The meadows and pasture grounds of Croatia are very inferior to those of Hungary or Carniola; but this is owing much to the indolence of the inhabitants, and the little care that is taken to improve them. Some of them are covered with furze and briars; and the grass, after it is mown, is in general so completely neglected, that one half of it is lost, and consequently, even in the most fertile districts, there is always a great scarcity of fodder. From this circumstance, the cattle of Croatia, though they constitute the chief riches of the inhabitants, particularly in the military districts, are worse fed, and worse managed, than in almost any other country. The horses are small and weak, totally unfit for hard labour. The oxen are also feeble and exhausted, for want of proper nourishment; and it often requires six pair of them to draw a plough. The cows are equally bad, and seldom give more than two pints of milk a day during summer, and three-quarters of a pint in spring or autumn. There are a few sheep and goats, and a considerable number of swine, which feed and fatten upon the acorns in the woods. The only poultry that is reared by the peasants are turkies, of which there are prodigious quantities. Woodcocks are found here in great plenty; and stags, roe-bucks, and hares, are very numerous in the forests. The rivers abound with all kinds of fish; and the inhabitants of the maritime districts derive their principal subsistence from the tunny fishing, which is carried on with great success on the coasts of the Adriatic. Bees and silk-worms are reared here with considerable care, and are, in general, very productive. In the county of Warasdin alone there are 4000 bee-hives; and, in 1801, the military districts of Banalgranze and Warasdin exported 971 quintals of honey and wax. The same districts, in 1804, produced $35,958\frac{3}{4}$ lb. of silk pods, which was an increase of $4,413\frac{1}{4}$ lb. above the average of former years. The reader may form a tolerably correct idea of the agriculture and produce of this country, from the following statement of the productive lands, &c. in the military department for 1802:

Productive lands	2,216,838	acres.
Of which are,		
Arable	692,477	do.
Meadows and pasture grounds	522,500	do.
Vineyards	14,887	do.
Orchards and gardens	13,947	do.
Forests	973,027	do.
Produce.		
Grain of different kinds	712,453	bushels.
Flax and hemp	48,983	quintals.
Hay	1,331,073	do.
Wine	150,721	*seaux.*
Schliwowitza	14,000	do.
Cattle.		
Horses	43,383	
Oxen	59,196	
Cows	54,711	
Calves	48,374	
Sheep	219,535	
Goats	46,589	
Swine	98,756	

The present inhabitants of Croatia are the Croats, who

Croatia.

Inhabitants.

are in general Catholics, and are supposed to have established themselves in this country in the beginning of the 7th century. There are also a considerable number of Illyrians from the Turkish provinces, who are of the Greek church, besides Bohemians, Carniolians, Germans, Italians, and a few Jews. The Croatian mountaineer differs considerably both in disposition and in manners from the inhabitants of the surrounding states. He retains many of the customs of his remote ancestors, and particularly that spirit of independence by which they were characterised. From his infancy he is inured to hardship. He is perhaps brought into the world in the open fields, or on the side of a mountain, (if his mother has been overtaken in labour, when engaged in her ordinary occupation, as often happens from the hard work to which the women of this country are exposed,) and being wrapped in a piece of coarse cloth, or swaddled only in grass, he is immediately carried to church to be baptized. His habitation scarcely shelters him from the inclemencies of a rigorous and inconstant climate. He often feeds upon the coarsest fare; and from the frequent scarcities which prevail, and the summer droughts, he is no stranger to hunger and thirst. In the military districts he is trained to the firelock from his earliest years; and soon acquires a martial appearance, and a vigorous constitution.

The inhabitants of Licca are particularly tall and well made, of a brown complexion, a masculine air, and fierce aspect; and their voice is rough and loud. They are brave, and excessively fond of military glory; and the women will even equal in the field the feats of their husbands. They call themselves Junack (heroes,) a title which they pretend was bestowed upon them by strangers. But the most courageous of all are the Bunjifzi, who make most excellent soldiers, and generally compose the chosen militia of the country. They are devoid of all fear; and the common amusement of the young Bunjifzi is to clamber up the highest rocks on the shore, and to precipitate themselves from thence into the sea. The Croatians of the plains, however, are in many respects very inferior. They possess neither the courage, the independent demeanour, nor the bodily strength and activity of their brethren on the hills. They are enervated by premature marriages, which they generally enter into before they are fifteen years of age, their principal anxiety being to increase the number of females, upon whom devolve not only the whole management of the family, but often also the most laborious duties of agriculture; and their constitutions are farther enfeebled by the diseases incident to a sultry and humid climate. The common cure among them is cupping and bleeding, while the universal remedy among the inhabitants of the mountains is a glass of brandy mixed with pepper, or a composition of wine, vinegar, and garlic. In fevers, they use a decoction of black hellebore often with great success; but should the malady resist this remedy, they return again to brandy, mixing it with great quantities of pepper and ginger.

Houses.

The houses of the Croatian peasantry are of wood, and generally of their own construction. They consist of two apartments, one for the family and their provisions, and the other for their cattle; and the best of them are but miserable hovels, without either windows or chimneys. The hard earth is their only bed, except that of the head of the family, or of the more wealthy peasants, which is composed of a few planks raised a little from the ground, and covered with straw and sheepskins. Their furniture consists of a low table, a large trunk for keeping their money and other effects, a kettle, one or two earthen pots, a few porringers and wooden spoons, and one or two hatchets. Each carries a knife for himself, which he uses at meals, and for making several little household utensils, which is generally their employment at leisure hours. In one of these huts, sometimes 50 or 60 persons, of four generations, live together in the greatest harmony. The oldest, who is called *Gospodar*, is absolute chief of the family, and directs all the out-work; while his wife, or the oldest female, who is called Gospodina, is entrusted with the care and education of the children, and the management of the house. All their clothes are made by the women, who both spin the flax or wool, and weave it into cloth. The common dress is a shirt with large sleeves, having the neck, which is always open, and the wrists embroidered with blue woollen thread; a vest, after the Hungarian fashion, with a double row of buttons; white pantaloons; short woollen stockings; and sometimes Hungarian boots. In a red belt the Croatian carries his pistols, and a long knife called hanshar, and over all he throws a red cloak. The richer inhabitants wear a long pelisse of green or blue cloth, which they use chiefly for show, and which they seldom lay aside even in the hottest weather. Their principal ornaments consist of ten or twelve silver rings fastened to the left side of the vest, which make a gingling noise when they walk. This is always considered as a sign of gentility, as are also large silver buttons on the pelisse. The Illyrians wear in general a red bonnet, and the Croats a hat or a fur cap. The shirt of the women descends to the feet, and its sleeves, which are of finer cloth and embroidered, are tied with silk ribbons; a woollen robe of the same length is bound round the waist with a girdle, and fastened on the breast with large silver clasps, gilt and ornamented with false stones. An apron before and behind is formed of pieces of fringed carpet of different colours; and their stockings are of blue cloth intermixed with small pieces of red and green. During summer they throw aside the woollen robe, but retain all the rest. Their hair is plaited in two tresses, which hang down upon the breast, and which have small bells, counters, and other ornaments fastened to their extremity. Among the more wealthy these are formed of gold, silver, or mother-of pearl, and are sometimes so numerous that the weight of half a pound is suspended from each tress. They wear upon the head an embroidered handkerchief after the Turkish fashion, and cover the fingers, and even the thumb, with a profusion of brass rings. Girls, however, have only one tress, which is decked with ribbons, and cover the head with a small red bonnet trimmed with gold or silver lace.

Food.

The common food of the Croats consists of bread and other farinaceous preparations, milk and cheese. Those in the plains, live much upon fruit, and few of them can afford wheaten bread. They use very little butcher meat; and it is only at marriage feasts, or at the conclusion of the hay season, and harvest, that they can indulge themselves with such dainties. The prevailing dishes are pottage, the same as in Scotland, but seasoned with butter or oil, and sometimes milk; vermicelli; and chou-croute. Oat-bread is in general use, but they also bake in the cinders a kind of unleavened cake of flower, barley, and rye, which they call *pogatschen*; and during Lent they eat nothing but herbs and roots, boiled in water, with a little salt. Dalmatian wine is the favourite beverage of the inhabitants of Licca, but they have seldom an opportunity of regaling themselves with it, except on great feast days. A liquor made from pears and barberries often supplies its place, and in general they content themselves with water or milk. In the wine districts, wine is in general use, but the produce of their vineyard seldom lasts above five or six months, never almost until the new vintage.

Character.

The moral character both of the Croats and Illyrians, is a mixture of good and bad qualities, frequently found even among the most uncivilized and savage tribes. They are hospitable, frugal, patient of fatigue and hunger, and always ready to oblige and assist one another; but they are, on the other hand, revengeful, indolent, intemperate, deceitful, and addicted to robbery. On the mountains, every one who arrives during a repast, is obliged to partake; and the master of a family would consider it an indelible reproach, were the traveller, or even a beggar, allowed to depart without tasting his hospitality. When compelled to endure hardship and deprivation, the Croat submits with cheerfulness; but he is in general a stranger to every kind of industry. He passes the greatest part of the day in doing nothing, while the women are continually exposed to the most laborious drudgery. "A stranger," says M. Demian, "is surprised to meet among the mountains of Wellabit and Kapella, a woman of Licca, with a large bag upon her head, a child upon her back, and another in her arms, journeying ten or twelve leagues a-day, and at the same time singing and spinning on the distaff, while her husband walks by her side without the slightest burden, solely occupied in smoking his pipe." The Croat is honest and faithful in all his dealings with his own countrymen, but an enemy to every other nation. Towards his superior he is submissive and cringing, when he wishes to gain any thing; but when he expects nothing, he is insolent and disobedient. The severity of military discipline has rendered the Illyrian particularly cunning and suspicious; and he is more inclined to robbery and brigandage than the Croat. He is also more addicted to intemperance, and the common seasons of dissipation are a marriage, a family feast, called *Kesznoime*, the anniversary of a saint, and a funeral. A marriage feast will often last several weeks, and will sometimes swallow up half a year's income. A funeral is almost equally expensive; and the father of a family, even when his wife, his mother, or his child, is lying in the agonies of death, will be busily employed in borrowing money from his neighbours, in order to purchase Dalmatian wine for the approaching entertainment. The marriage and funeral ceremonies are the same throughout the whole country; and though the Croats and Illyrians have customs peculiar to their respective origins and religions, yet they agree in these, which, indeed, in most countries, generally fix the national character.

Manufactures.

In Croatia, the arts and manufactures are almost completely neglected, and except in the principal cities and towns, where a few of the more simple and common trades are practised, there is scarcely a professed artist or manufacturer to be found in the country. Every peasant makes his own furniture, his own clothes, and even his husbandry utensils; and throughout the whole of military Croatia, containing a population of more than 376,000, there are only 2102 handicraftsmen who live by their trade. Its principal manufactures are confined to the city of Fiume, in which are made annually about 35,000 quintals of refined sugar, and 1400 *eimers* of liqueurs, both of which are mostly consumed in the Austrian provinces; 850 quintals of tanned leather; 900 quintals of wax; 3000 quintals of cordage, manufactured of Italian hemp; 2000 measures of potash; 10,000 quintals of snuff, equal to the best of Dunkirk; besides hats, delf-ware, and some cloth. There are also a sail, anchor, and cordage manufactory at Zengg; a paper-mill near Agram; glass-houses at Szusicza, and near Warasdin; a pottery at Ivanitsh; iron-forges at Tschuber and at Merzladovicza, and a copper-forge at Szamabor; a considerable number of saw-mills, of which there are nineteen in the military district of Carlstadt; and dock-yards for building coasting-vessels at Buccari, Fiume, and Porto Ré.

Inland commerce.

From the account that has been given of the productions and manufactures of Croatia, it cannot be expected, that, after supplying its own wants, it will have any great superfluity to spare to its neighbours. With the exception of wood, cattle, and a little corn, therefore, its commerce consists chiefly in exchanging the commodities and productions of other countries. Kostainicza, a frontier town on the banks of the Unna, is the great staple of its land commerce, which indeed is but inconsiderable. It draws from Turkey raw hides, which pass into Austria, dressed sheep-skins, furs, vine-shoots, honey, lintseed, a great number of cattle and pigs, destined for Italy and the Austrian states, and some horses, amounting in all, between the years 1794 and 1803, to 649,626 florins and 15 kreutchers; while Croatia in return, gives in the same time, a small quantity of schliwowitza, hemp, mercery, steel, earthen-ware, copper utensils, linen, *opanken* or Croatian shoes, salt, sieves, soap, and tobacco, to the value of only 58,332 florins 36 kreutchers; making a balance in favour of the Turks of 591,283 florins 39 kreutchers. The oxen which come from Sclavonia, Hungary, and Bosnia, are fed on the pastures of Croatia, and are generally bought by the merchants of Carniola, and carried to Venice. The number of pigs and horned cattle exported, in 1082, from the military district of Warasdin amounted to 6,138 head, and were valued at 114,966 florins. The merchants of Ivanich carry on a considerable traffic in honey and wax, which they send to Oedenburg and Upper Austria; and Austria draws also a little corn from the counties of Warasdin and Agram.

Maritime commerce.

The maritime commerce of Croatia, however, is more important. Hungarian corn is its principal export, which is brought up the Save as far as Sissek, and then conveyed by the Culpa to Carlstadt, which is the great emporium of Hungarian produce. It is then transported by the Caroline road to Fiume, or by the Josephine road to Zengg. In 1794, there were loaded at its principal sea-ports 100,000 bushels of wheat, 200,000 bushels of oats, chiefly for Dalmatia, Genoa, Trieste, and Cadiz; and between the years 1800 and 1804, about 60,000 quintals of corn were annually transported from Carlstadt to Zengg. Another valuable article of their maritime commerce is tobacco, which is exported, partly manufactured and partly in leaves, to Genoa, Ancona, and Naples. In 1780, its exportation amounted to 24,905 quintals; but, in 1792, this quantity was diminished to 10,918 quintals. It has of late years, however, been again on the increase. Wood forms another important object of exportation; and were the means of conveyance in any degree commensurate with the immense forests which cover this country, Croatia could vie with any nation in Europe in this lucrative trade; but for want of proper roads, very little of its excellent timber

Croatia. Commerce.

can be brought to the market. Such, indeed, only as grows in the vicinity of the coast is of any use in this respect; and the city of Fiume is even obliged to draw its cargoes from the forests of Cluna in Carniola. Markets for cattle are held several times a year near Fiume, where large herds are brought down from the interior for exportation to Italy and Venice, and are generally exchanged for salt. In 1801, the military district of Carlstadt alone furnished cattle to the value of 234,383 florins 37 kreutchers. The other exports of Croatia are honey and wax, to Venice, Trieste, and Messina; glass to Italy; and also some sugar, cordage, cloth, &c.

The principal imports of Croatia, for its own consumption, consist in sea-salt, Dalmatian wine, oil, sugar, maize, and hemp. The salt is derived chiefly from the Venetian Islands, and also from Barletta and Manfredonia, in the kingdom of Naples. The consumption of this article in the military districts alone, was valued, in 1801, at 230,000 florins. The annual importation of wine from Dalmatia amounts to 700,000 florins, and of brown sugar, for the refining house at Fiume, to about 600,000 florins. A considerable quantity of maize is brought from Romania and the Venetian Islands, which is used by the inhabitants of the coast, and of the adjacent mountains of Carniola, in making their bread and *polenta*. In the eastern districts of Croatia, however, as well as in Sclavonia and Hungary, this grain is used only for feeding pigs. A more precise idea of the nature and importance of Croatian commerce will be derived from the following Tables:

Articles exported in the year 1780.		*Articles imported in the year* 1784.	
Tobacco,	24,905 quintals.	Cotton, to the amount of	35,000 florins.
Wool,	158 do.	Coffee,	67,000 do.
Cheese,	23 do.	Hides,	22,000 do.
Tallow and soap,	209 do.	Hemp,	48,000 do.
Corn,	22,762 sacks.	Maize and other corn,	148,000 do.
Charcoal,	28,612 paniers.	Citrons,	6000 do.
Staves,	158,935	Linen,	19,000 do.
Potash,	1249 quintals.	Olive oil,	38,000 do.
Hides,	381 do.	Paper,	6000 do.
Honey and Wax,	598 do.	Rice,	9000 do.
Glass-ware,	267 do.	Sea salt,	54,000 do.
Refined sugar,	3883 do.	Wine from Austria,	28,000 do.
Syrup,	929 do.	Do. from foreign countries,	26,000 do.
Dried and salted fish,	330 do.	Brown sugar,	369,000 do.
Salted meat,	413 do.		
Cordage,	218 do.		
Prunes,	97 do.		

Value of articles imported and exported during the years 1793 *and* 1794, *at the sea-ports of Fiume, Buccari, Porto-Ré, Czirkvenicze, Szeloze, and Novi.*

	Imported.				Exported.			
	1793.		1794.		1793.		1794.	
	Florins.	Kr.	Florins.	Kr.	Florins.	Kr.	Florins.	Kr.
From the maritime provinces of Austria and Hungary,	478,376	44	567,003	51	422,298	45½	972,684	49½
From foreign countries,	689,507	34	569,672	53	1,626,754	39	876,933	45½
	1,167,884	18	1,136,676	44	2,049,053	24½	1,849,618	35
					1,167,884	18	1,136,676	44
Balance in favour of the country,					831,169	6½	712,942	50

The number of vessels which arrived at the above ports, in 1794, was 2375, and 2353 departed.

The commerce of this country suffers greatly from the want of proper means of conveyance. None of its navigable rivers run towards the Adriatic, but, taking an easterly direction, fall into the Danube, whose lengthened course, after it receives their waters, before it reaches the ocean, renders them of very little service in expediting the conveyance of its produce towards the coast. These rivers are also of very difficult navigation. Immense trees half sunk in their bed, requires the greatest address on the part of the sailors to avoid; and indeed, the circumstance of these rivers being so frequently liable to change their course, precludes all expectation that these defects will ever be completely remedied. Attempts were made some years ago to facilitate the navigation of the Save; but it has as yet come to nothing, though the estates of Carniola voted 12,000 florins for the purpose. It was also in contemplation, in 1771, to render the Culpa navigable from Carlstadt to Brod, which would have been of vast importance to the commerce of Hungary. The project was renewed in 1800 by a society, at the head of which was the Bishop of Agram; but no decided measures have yet been taken for its ac-

Croatia. complishment. The only method of transporting merchandize from Carlstadt to the coast is by land, which is so troublesome and expensive, that the merchants of Fiume and other sea-ports can draw their supplies at a cheaper rate from the Italian and Venetian states. The principal roads in this direction are the Caroline way and the Josephine way. The former, which reaches from Carlstadt to Fiume, and is about 85 miles in length, was formed in 1726 by Charles VI. It is cut entirely in the rock of the mountain which it traverses; but is very injudiciously planned, and almost totally unfit for waggons. Another road has been projected in the same direction, and is already finished as far as Merselwodicze. The declivities are more gentle, and it is in every way more convenient for passengers. The Josephine way lies between Carlstadt and Zengg, and passes over the Kapella. It is both shorter and less mountainous than the Caroline way; and 300 workmen are employed in keeping it in repair. The other roads are very indifferent. The route from Carlstadt to Austria passes through Carniola and Carinthia, by Motting, Laybach, and Klagenfurth; that from Agram is by Cilli in Styria, and Volkermarkt in Carinthia; and that from Warasdin is also through Styria and Carinthia, by Pettau and Mahrburg. The road to Hungary takes the direction of Kopreinitz and Dernje, and that to Sclavonia is by Ludbring. But what is still more grievous than the inconvenience of bad roads, is the dishonesty of the waggoners. It is almost impossible to trust them with any kind of merchandize, particularly corn, which they frequently sell for their own advantage, or pawn for liquor at the inns on the road.

As Croatia forms an integral part of the kingdom of Hungary, we must refer our readers to that article for information respecting its government, the administration of justice, its revenue, military force, and other public establishments; also, its coins, weights, and measures. We may here merely observe, that when Croatia attained its present extent in the reign of Leopold I. it was divided by that prince into counties, to which he nominated governors, called *Obergespanne*, who, however, did not then enter upon their office, as the counties were immediately submitted to other administrators, named *Ban*, a word signifying lord in the Croatian language. They were, however, effectually installed into their office in the reign of Maria Theresa, and made responsible to a council, whose president was the *ban* of Croatia.

Religion. The inhabitants of Croatia profess, in general, the Roman Catholic religion, though in the military department there is a great proportion of Greek schismatics. The Roman Catholics are under the jurisdiction of the diocesan bishops of Agram and Zengg, the former of whom is the richest dignitary of the kingdom. He possesses immense domains in Croatia and the Bannat, which yield him an annual revenue of 111,000 florins; and also other considerable privileges, among which is the sovereignty over 105 vassal barons, who hold their fiefs immediately from him, and pay an annual acknowledgment of two or three ducats. His metropolitan chapter is the most numerous in the Hungarian states, and consists of a provost, and twenty-seven canons. The bishop of Zengg has a revenue of 12,000 florins a year, and his chapter consists of a provost and five canons. The number of Roman Catholic parishes in Croatia amount to 359, of which 253 are in the diocese of Agram, and 106 in that of Zengg. There are also 16 convents. The Greek schismatic church possesses 158 parishes in Croatia, of which 149 are in the military department; and besides its parish churches, it has 77 chapels of ease. To these are attached 302 ecclesiastics, who are subject to the authority of the bishops of Carlstadt and Pakratz, and are maintained entirely at the expence of their flocks. Government contributes nothing either to the building of their churches, or the support of their pastors. Even the Catholic clergy in some of the districts depend upon the stated contributions of their parishioners, which is fixed by law;—every peasant paying so much for every acre of arable land, &c. The Croatian Catholics, though very deficienti n religious knowledge, are neither so ignorant nor superstitious as the Greek schismatics. These last make the whole of their religion to consist in the hearing of mass, and the observance of Lent, which are the continual subjects of the discourses which they hear from the pulpit; and they consider robbery or murder more venial crimes, than to eat during Lent with a spoon that has been dipped in broth. Few of them can repeat the Lord's Prayer, or know even how to make the sign of the cross. The clergy are almost equally ignorant with their parishioners, and often more immoral; and are treated with respect only when engaged in their public duties. Though the Protestant religion is tolerated by an edict of Joseph II. yet there are scarcely any of the inhabitants of that persuasion. In 1802, there were only five Protestants in the whole military department.

Education. In Croatia there are no seminaries of education of any repute; and there is not an individual in the kingdom who has made any figure either in the arts or sciences. In the civil department, there are only 35 public schools for Catholics, supported by government, besides three lyceums. Each of these lyceums has five professors, and are, in general, well attended. In 1804, there were at Agram, 309 students; at Warasdin, 280; and at Fiume, 92. There is also an academy at Agram, consisting of ten for the study of law and philosophy. In military Croatia there are fifty-three national schools, besides a lyceum at Zengg. These schools, however, were instituted by government solely for Catholics, though in this department nearly one half of the population belong to the Greek church; and there are only five schools in Croatia for the instruction of Greek schismatics.

Population. Considering the general sterility of this country, the indolence of its inhabitants, and their ignorance in almost every branch of rural economy, one would be led to expect rather a scanty population; but so far is this from being the case, that, in proportion to its extent, Croatia contains more inhabitants than any of the other Hungarian states, and surpasses in this respect even the Austrian provinces of Carniola, Carinthia, and Western Gallicia. According to Lichtenstern, the population of civil or provincial Croatia in 1787, amounted to 388,854; and by the census taken in 1802, that of the military department was 376,180. According to the latest and most authentic statistical tables, there are in

	Civil Croatia.	Military Croatia.
Cities	7	6
Market Towns	13	
Villages	2080	1240
Prædien	8	
Houses	40,046	36,307
Total number of houses		76,353
Total number of inhabitants		765,034

Crocodile. None of the villages are built with any regularity, but generally consist of a number of huts scattered up and down at a considerable distance from each other. The houses are for the most part constructed of wood except upon the coast, and in some of the principal cities and towns, where stones or brick are used, and sometimes marble. Cities. The principal cities are: *Agram* or Zagrab on the Save, the capital and a bishop's see, which is a well built and populous town, containing nearly 9000 inhabitants; *Carlstadt* on the Culpa, built in 1579, and defended by a fortress; *Warasdin*, situated in a plain on the Drave, with a castle, and 4000 inhabitants: *Fiume*, a sea-port on the Adriatic, with a citadel and a tolerable harbour; *Zengg*, a well fortified little town near the sea, containing several churches and convents, and 2744 inhabitants; and *Carlsbago*, a trading town south of Zengg, with a good harbour, and 995 inhabitants. See Demian *Tableau Geographique et Politique des Royaumes de Hongrie*, &c. (*p*)

CROCODILE. This is an amphibious animal, which may be ranked among the most hideous and disgusting of all that nature has disseminated over the earth, or in the waters. Aversion and alarm are equally excited by its appearance in those countries which it infests; and where it is only known by name, its treacherous ferocity has become proverbial.

Naturalists have scarcely established the real difference between the crocodile and the alligator: some maintain that they are identically of the same species, that the crocodile of the Nile is the alligator of St Domingo, Louisiana, or Carolina, while others conceive that there are slight distinctions between them. Cuvier enumerates twelve, however, which he concludes are different either from structure or habits; six *crocodiles* properly so called, four *alligators*, and two *gavials* or *longirostres*. Our observations shall therefore be general, and such as are applicable to those characterised as the crocodile of the Nile, the Gangetic crocodile, and the alligator.

The crocodile is a lizard of enormous size, covered with scales, which are so hard as to resist a musket-ball: its feet are provided with strong sharp claws, and an immense mouth opening as far as the ears, exhibits two rows of teeth like a saw, fitting into each other when it is closed; the eyes are large, prominent, situated on the very summit of the head, and covered by a membrane like that of some birds; the ears, or auditory orifices, situated a little above them, are also covered by membranes, having a longitudinal slit in the middle. In general the colour is yellowish, shaded with brown: dull green, with brown bands, or brown with yellow bands. One species is called the black crocodile, from its colour; but possibly that of the whole is affected by the place they inhabit; for animals dwelling in mud, acquire a dingy hue, which diminishes on changing their abode to pure water: the colour, besides, alters with age. The whole body is impregnated with a strong odour of musk, sometimes affecting the waters, where great numbers collect together, and is sensible at the distance of an hundred yards; but those which repair to the sea are divested of it.

If we except the elephant, the rhinoceros, and hippopotamus, the bulk of the crocodile perhaps exceeds that of every other terrestrial animal; no fishes frequenting fresh waters equal it, and but a few species of those belonging to the seas. The largest are not less than thirty feet in length, and one of only half that size is five feet in circumference: the body stands low on the ground, and the animal universally presents a dull and sluggish aspect. Nevertheless, its motions in pursuit of prey are not slow; and the difficulty which it finds in turning is the surest means of escape on land: its agility in water is infinitely greater.

These facts are better illustrated when the animal is roused to action. Its natural abode is in the water, for scarcely one fourth of its existence is passed on the earth; whence those narratives which affirm that it lives entire months without that element, are not easily to be credited. The muddy edges and thick reeds of slow and tranquil streams are its favourite haunts; and it sometimes descends rivers to within the flowing of the tide. On leaving them, it advances always with a slow pace, nearly in a straight line, its belly frequently dragging on the ground, and its head commonly elevated before it. However, it is seldom seen standing, and its chief enjoyment seems to be lying in a state of absolute quiescence. When in pursuit of prey, it swims gently and silently, just on a level with the water, until it approaches the place where some terrestrial animal comes to quench its thirst. Then curving its tail, it strikes the animal a violent blow, which is invariably in the direction of the water, and at the same time towards its own mouth. Should the animal surprised be of large size, such as a horse or an ox, the crocodile adopts another manœuvre, in seizing it by the nostrils, and forcibly dragging it under the water to be drowned. When a tortoise is seized, the crocodile raises its head above water, and with the inconceivable strength of its jaws, crushes the shell in pieces. Men, and particularly negroes, are said to be its favourite prey; and it is greedy after the flesh of dogs; and hence the negroes that hunt the crocodile are accustomed to beat the dogs, on purpose that their howling may attract it from its haunts. The prey being drowned, is conveyed to some subaquatic hole or receptacle, and left to putrefy before it is devoured: but the crocodile cannot feed in the water; it would then, as is usually credited, experience the same fate as its victim; therefore, except small fihes, the prey is always carried to the land: its structure also is such, that it must rise to the surface once in an hour, or hour and a half for breathing. Nothing that it once seizes can escape; it never quits its hold: even strong levers forced between the jaws for that purpose, have proved ineffectual; and, shaking its prey to pieces, it is swallowed without mastication. Much has been said of the stratagems employed by the crocodile to seize its prey; that it lies like a log on the banks of rivers, or floats inactive on the surface, and then springs forward whenever the victim comes within its reach. This may be partly true, though it appears under many exaggerations; for it is well authenticated, that it remains motionless until considerable objects are quite close, and evidently within its reach; then it leaps upon them. The agility of the crocodile is not so great, even when in pursuit of prey, that a man at tolerable speed may not escape, more especially by frequent deviation from the straight path: the blow with the tail, suddenly given, is principally to be dreaded, and the irascibility of the animal when attacked, or the female at the head of her young.

But in some countries, there are certain seasons when the crocodile may be assailed with impunity. Subject, like all other lizards, to torpidity, on the approach of cold, it passes part of the year in the most northerly latitudes, in a state of insensibility. It inhabits none excepting the warmer countries, and where winter is of the shortest duration; were its abode extended to the colder, it would so easily be overcome by its enemies, that the race would soon be extirpated. In North Carolina, which is within 37° of the equator, these animals are said to make large subaquatic burrows, entering two or three feet from the surface, and ascending steep banks considerably above it, where they pass the winter in a lethargic slumber. In Louisiana, according to M. de la Condamine, immediately on commencement of the colder season, thev retreat to the clayey bottom of marshes to become torpid, though the cold is not so intense as to deprive their limbs of flexibility. "The winter of that country not being rigorous, and frequently interrupted by warm days, these alternations occasion so many resurrections in the crocodile: on some days it is only in a slight state of insensibility: on others, the lethargy is so profound, that it may be cut in pieces without testifying the smallest sign of animation." The voice of the crocodile is a loud hollow growling of the most terrific description, which has been compared to the roaring of a bull; and it is principally exercised when the animal is enraged, or leaves its subaquatic retreats in spring: thus Dr Brickell observes, "these monsters roar and make a most hideous noise against bad weather, and before they come out of their dens in the spring. I was very much frighted by one of them in a creek near Bath Town, where these animals are very plenty, which happened after this manner: As I was walking near the creek side one evening, not long after my arrival in those parts, on a sudden this monster began to roar after such a dreadful manner, that the very earth seemed to tremble where I stood. I am not able to express the consternation I was in; for I am satisfied it gave me the greatest dread and surprise I was ever in, never having heard so terrifying a noise before. It continued thus roaring for eight or ten times like a bittern, but if possible an hundred times louder, which at first I imagined to be some diabolical spirit breaking through the bowels of the earth; for in the fright I was in I could think or imagine nothing else."

The crocodile propagates by eggs, of very small dimensions compared with its own enormous size; for they are little larger than those of a goose. Like many animals noxious to the more estimable parts of the creation, it is prolific, though the precise extent of its fecundity, except in a single species, is not ascertained. Some naturalists affirm that it lays an hundred eggs in a season, others fifty, and the Count La Cepede concludes, that the number may be about seventy-two. Recent observations, however, by an intelligent investigator of the whole history of this animal, prove that the crocodile of St Domingo lays only twenty-eight.

The males are infinitely more numerous than the females; from which and other circumstances it is inferred, that the crocodile is polygamous. Fierce combats for the possession of the females take place in the water during the breeding season, terrifying all the surrounding animals to flight; and the male, in displaying more than ordinary agility, announces his attachment by a horrible growling.

The female crocodile of St Domingo scrapes a round cavity in the earth, by means of her feet and snout, in which twenty-eight eggs are deposited, in circular arrangement, and all in such a manner as not to touch each other. They are laid in successive rows, the lower being protected from the superincumbent one by a bed of earth interposed. The nest is situated in a dry hillock, and the earth also fashioned into a conical form, so that the eggs lie at the depth of ten inches from the surface. This being done, the mother abandons them to be hatched by the sun: yet instinct prompts her frequently to revisit the spot, as the term of exclusion approaches. She then testifies uncommon agitation, roaming about the place, and uttering a peculiar growling, as if to awaken her hideous offspring to animation. The period of maturity being at length attained, the nascent crocodiles answer to her solicitude, by a kind of yelping like puppies. A hollow murmur in return denotes her satisfaction; and she hastens to scrape up the earth with such anxiety, that several of the young are always crushed under her unwieldy body. Having withdrawn them from their nest, the mother leads them straightway to the neighbouring water: but now her utmost vigilance is required for their preservation; for, unlike the instinct by which she is animated, the male, silently approaching, will frequently devour them before she is aware of her loss. He perpetually seeks their destruction; and the watch of the female over her young is protracted for three months from their origin.

An opinion is prevalent, that the crocodile continues growing during its whole existence, that it lives to a great age, and that the utmost limits of its size are scarcely known; whence, in addition to well-authenticated instances of some being twenty-five or thirty feet in length, others are reputed to attain the enormous dimensions of fifty feet. Though we are not enabled, from positive and conclusive evidence, either to corroborate or controvert these facts, the observations of the naturalist already cited, throw considerable light upon the subject. Where animals live in a state of uninterrupted warfare, we are aware that there is little probability of their either attaining their extreme dimensions, or the utmost duration of life; and with respect to the latter, we are inclined to ascribe a much longer period to those that dwell in the waters than is usually allowed. The crocodile of the Nile, banished to the most southern parts of Egypt, is permitted to live undisturbed, and there it is universally admitted to increase to the largest size, far exceeding what is seen in other countries. But inferences may perhaps be made from the progressive growth of the crocodile of St Domingo.

This species is nine inches and a half in length at the moment it leaves the egg, and at one year old is two feet long. Its length is doubled in three years more: and at eight years it is six feet seven inches: at sixteen years old, it is twelve feet and a half in length; and at twenty it is sixteen and a half. It now ceases to grow, and in two years more exhibits all the marks of old age. The males begin to breed at the age of ten, and the females when eight or nine; but the latter do not continue propagating above five years.

Were not the fecundity of the more powerful and destructive animals repressed either by the attack of open enemies, or their own liability to perish, they would speedily overrun the earth. It is thus that almost all are confined within moderate bounds; that destruction is ever commensurate with multiplication, and sometimes by its preponderance entire species become extinct. Many animals have inhabited this island, of which there have only been fossil remains for ages; and record has preserved the period when the last of a noxious race was destroyed. In certain places once infested by the crocodile, it is now totally extirpated, and in others its appearance is rare. In its earliest stage, we have seen that it is liable to perish, either from being crushed to death

Crocodile. by the female, or devoured by the male. A species of tortoise frequenting the Nile, makes incredible havoc among the young: and in Louisiana, another tortoise of monstrous size, ventures, with success, to attack those of considerable growth. The hostility of the ichneumon has been related from times of remote antiquity; and if we cannot agree that it proves destructive of the crocodile itself, we at least know that it devours the eggs. In this manner, the numbers of so formidable a creature, when less capable of defence, are diminished; but after having attained its utmost power, different means repress its voracity, and other enemies are on the watch for its destruction. Although the crocodile drags its prey under water to extinguish life, we have already remarked, that it must resort to shallows or the land to feed upon it; and in like manner, when attacked by the swordfish or shark, it is easily vanquished, for on opening its mouth in resistance, a torrent of water rushes in, and it is drowned. Of all the enemies, however, which the crocodile has to dread, the most inveterate is man. By a perpetual and sanguinary war carried on against it almost in every country, and by the various devices adopted for its capture, the race is prodigiously reduced. But it is no easy matter to overcome an animal endowed with such immoderate strength, and whose hide in general is impenetrable by a leaden musket ball. It is, however, more vulnerable in the belly, and a bullet discharged down the throat or into the eyes is fatal. Even harpoons or spears will penetrate the body, and will inflict mortal wounds when thrown from a skilful hand. The negroes of the river Senegal attack this huge animal either when asleep, or in shallows where its swimming is impeded, and by forcing an ox hide into its mouth, the water flows in, while heavy blows are given on the head to stun it, and it is drowned. In Louisiana, the natives contrive to thrust a piece of wood pointed at both ends into its throat; or when rushing upon the assailants, its wide mouth is met by a large stake, which is forcibly thrust down, and it is speedily destroyed. Long iron spikes are concealed in a bait, which penetrate both jaws as the animal bites; and many different methods are employed for the same object. Pits are dug for it in Egypt, and in St Domingo strong nets are spread, and it is either hunted on foot with muskets and pikes, or harpooned from boats. The animal floating like a log on the surface of the water, remains motionless until a boat is almost in contact with it; or when rising to breathe, the harpooner, by a dexterous blow, transfixes its body, and allows his line to run out. The wounded crocodile invariably descends, but the flowing blood marks its progress, and it is quickly followed by the boat; or roaring hideously, it dashes the water violently with its tail, alternately dives and returns until it is drowned, or dies from the weapon. Hunting the animal on shore is a more arduous undertaking; for, on seeking its usual haunts among the mud of fallen rivers, or thick and marshy places overgrown with weeds, frequently others start up after one is in view, and endanger the huntsman. Sometimes also the clayey bottom yielding to his weight, retains him until the crocodile's approach puts his life in imminent hazard. Besides lurking in the mud, in shallows, or among weeds, this creature retreats to holes in the banks of rivers; and the dislodging him from these, constitutes another kind of pursuit, infinitely more dangerous than any of the others: here it becomes ferocious, and resists its assailant, whereas in the water it flies before him. Several persons, armed with muskets and pikes, commonly join in the amusement, and the animal, when its retreat is discovered, is provoked to come forth by thrusting in poles. The huntsman then taking a steady aim, tries to strike the most vulnerable part; but in doing so, he must preserve extreme caution, and above all, keep at a certain distance, because the crocodile not only furiously issues out, but nimbly strikes an object with its tail towards its mouth, which is always widely distended, A recent instance occurred, where the destruction of a female crocodile, known to be near her nest, being projected, a single huntsman ventured on the pursuit. But he was himself surprised, by the animal suddenly darting from a thicket and seizing him by the thigh. The extreme torture he endured, rendered him incapable of defence, and the animal retreating backward through a narrow path, led him to anticipate a horrible death. Some accidental circumstance, however, induced it, contrary to the nature of the species, to quit its hold; the huntsman had sufficient presence of mind to present the butt end of his musket, and while the crocodile forcibly closed its jaws upon it, he took advantage of his remaining strength to escape, by screening himself from its sight. It was with much care and difficulty that he recovered from the injury. Crocodile.

From the uninterrupted pursuit of the crocodile, by these and many other methods, its multiplication is repressed. Whence M. de la Borde concludes, that not above five or six of a whole brood escape.

All the amphibia are tenacious of life. Dr Brickell says, " after the tail is cut off from the body of this creature, it will freely move for four or five days, as if it had been alive, and still joined with the other parts." Several leaden bullets, even when they penetrate, are sometimes insufficient to kill the crocodile, unless when they reach the brain, the spine, or some of the larger blood vessels. From the extreme hardness of the scales, iron balls are recommended as more effectual. In common also with most amphibia, it can survive a considerable time in abstinence; and on being opened, large stones are often found in its stomach. The use of these is not known; the vulgar affirm that there is one for each year of the animal's age, which is controverted by the best observations; and the most probable theory now formed is, that they assist in triturating the food, and enable the animal to suffer longer abstinence. Some naturalists have testified their surprise, that abstinence should not abate the ferocity of the crocodile. But it appears in general, that every animal, man not excepted, becomes more sanguinary, cruel, and ferocious, from the pain of hunger; and if we are to believe that hunger tames the lion, it is by superinducing a debility, which checks the power of exertion.

It has been confidently maintained, that the innate ferocity of the crocodile, which prompts it to bite even on bursting the shell, renders it untameable. We may ask, however, is any animal untameable? is it well established, that among quadrupeds, birds, and even those fishes and insects over which restraint can be obtained, there are any which may not be familiarized with mankind? On maturely considering the observations of naturalists, there is scarcely a single animal which may not be rendered docile. Those persons best acquainted with the means, have undoubtedly made the most ferocious tractable, either by terrifying them into subjection, or familiarizing them with habits opposite to those bestowed by nature. Thus the crocodile has certainly been tamed, and probably superstition, which ever subdues human reason, first taught mankind to do so, and to elevate this the most hideous of animals into a divinity. Nearly five hundred years before the Christian era, the inhabitants of Thebes esteemed the crocodiles of the lake Mœris sacred: from a number that were tamed, one in particular was selected, which was carefully fed and preserved; ornaments of gold or jewels were hung from the ears, and rings or chains, as a kind of bracelets, adorned the fore-legs. When these crocodiles died, they were embalmed, or deposited in sacred places; and we are told that cities were dedicated to them.

We cannot reject the concurring testimony of authors, that the crocodile is a ferocious animal; but its ferocity has undoubtedly been very much exaggerated, arising perhaps from greater apprehensions at its appearance, than the real danger warranted; and, indeed, the natural ugliness of the animal, added to the perpetual exposure of a formidable row of long sharp teeth, uncovered by lips, are well calculated to excite alarm. But the crocodile always flies from man. Unless when pressed by hunger, when roused by provocation, or anxious for the safety of its young, it never ventures to attack him. The hundreds floating on the surface of rivers may, in general, be approached with confidence; and even when assailed on the land, their first impulse is flight. Adanson, Sonnini, Denon, all coincide in opinion, that the crocodile is less to be dreaded than we are taught to believe. If we can credit Labat, there is a certain village, which he calls Bot, on the western coast of Africa, where crocodiles often appear, without injuring any one. Nay, he goes so far as to say, that children sport with them, or beat them away, and still they testify no resentment. Possibly it might be the docility of individual crocodiles, that led to his general conclusion; but he accounts for it by observing, " that the care with which the negroes feed these carnivorous animals, has changed, or at least mollified, the natural badness of their disposition."—Most probably, it is this abundance of food that prevents them from seeking to satisfy the rapacity implanted in every being which preserves itself by the destruction of animal life. Aristotle has long ago said, that nothing more is required to tame crocodiles than a supply of food, while abstinence renders them dangerous. M. de la Borde has seen crocodiles kept in a bason at Cayenne along with turtles, to which, being fed, they did no injury; and, in the Isle of Boutan, some of these animals, it is said, are in a certain degree domesticated from similar treatment. That superstitious veneration with which the ancient Egyptians beheld the crocodile is not altogether wanting in modern times, though " at this day it is neither pursued nor reverenced; and is left in peace to impart its musky odour to the Nile, or clear its waters of fishes." But in India many of these creatures are subsisted in tanks or pools, by the eleemosynary donations of travellers, who bestow a trifle of money, or present some provision to mendicant priests, to be converted to their use. On hearing the voice of their purveyor, the crocodiles are said to leave the waters, and each receives a small cake of meal, or other provender. Scarcely less extraordinary are the superstitions of the Catholics in the convent of Neguade, in Upper Egypt, who bathe in the Nile without the slightest apprehension, while devoutly believing, that their Mahometan neighbours would infallibly be devoured, because they have no faith in Christ.

Notwithstanding the circumstances which we have now related, there are too many fatal examples of mankind having perished by the jaws of the crocodile; and although neither its rage nor rapacity may be excited, it is an animal which no one unguarded can ever approach with confidence.

The ancient Romans, always delighting in sanguinary spectacles, exhibited combats between these animals and men; and the Emperor Heliogabalus, in imitation of his predecessors, ordered them to be brought from Africa, for the amusement of himself and the populace. Five were at one time collected in an artificial pond by M. Scaurus, in the games given during the period that he was ædile.

Various parts of the crocodile were formerly supposed to possess peculiar virtues in the cure of disease, and they have lost none of their repute in modern credulity; but it is singular that there should be a coincidence of opinion on this subject between the Egyptians and the natives of North America. Hasselquist assures us, that the former esteem the fat an effectual remedy for rheumatism; to which property the Americans add the cure of cancers or ulceration. The Arabs consider the eyes the most powerful aphrodisiac, while in North America the same quality is thought to reside in the teeth. The negroes sometimes make a species of helmet of the scaly integument of the crocodile, from its capacity of resisting a musket ball from a distance, and the blow of a hatchet. Many of them devour their eggs voraciously; and, in certain countries, their flesh is a considerable article of subsistence. Chiefly for this purpose the animal is hunted; " when their tails are cut off, they look very fair and white, seemingly like the best of veal; and some people eat thereof, and say it is most delicious meat, when they are not musky." It is this musky taste and odour which renders the flesh of the crocodile disgusting to Europeans; and unless the scales of the breast are removed before the animal dies, it becomes unpalatable even to the Indians. See *Journal de Physique*, 1782, part. 2.; Catesby's *Natural History of North Carolina;* Brickell's *Natural History of North Carolina; Voyage a la Guiane et a Cayenne;* Labat *Nouvelle relation de l'Afrique Occidentale*, tom. 2. and 5.; Hasselquist's *Voyages and Travels;* Denon *Voyage dans la Basse et la Haute Egypte*, tom. 1.; Sonnini *Voyages*, tom. 3.; and Williamson's *Vade Mecum.* (c)

CROCUS, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 93.

CRŒSUS. See LYDIA.

CROIX, ST. See CRUZ, ST.

CROMARTY, a sea-port town on the eastern coast of Scotland, situated in the county of the same name. It was formerly a royal burgh; but the inhabitants, on account of the expence to which it subjected them, petitioned for a privation of their rights to send a representative to Parliament. The late proprietor, Mr George Ross, made great exertions to promote industry in this town, which induced government to contribute L. 7000 towards building a pier. Mr Ross erected extensive buildings for a brewery, and a hemp manufactory, which are still in a flourishing state. The manufactory sends annually to London about 10,000 pieces of bagging, which may be valued at about L. 25,000. Pickled pork, hams, and dried cod fish, form considerable articles of export. The bay of Cromarty has long been famed as one of the finest and safest harbours in Britain. It has been examined with the view to render it a naval depot; but though it is a safe retreat for ships in bad weather, it has been found unfit, from various circumstances, (particularly the distance of fresh water in sufficient quantity, and conveniently disposed for filling casks,) for being made a regular station. (S. K.)

CROMARTY, County of. This small district appears to have been erected into a shire at a very early period of our history. The office of sheriff was hereditary in the family of Urquhart of Cromarty, in which it was left at the conquest of Scotland by Edward. This shire originally extended no more than 10 miles, and its average breadth does not exceed $1\frac{3}{4}$ mile. The area, therefore, is only $17\frac{1}{2}$ square miles. George Viscount Tarbat, and afterwards Earl of Cromarty, procured an act of parliament in the year 1685, and another in the year 1698, by which all his property in Ross-shire was annexed to the county of Cromarty, which thus acquired an addition fifteen times its former extent. Many inconveniences have arisen from this annexation; but of late all acts of parliament relating to the improvement and police of Ross-shire, include the county of Cromarty, which is under the jurisdiction of the sheriff of Ross. A great part of Cromartyshire is well cultivated. In the old shire there are about 4000 acres of land in cultivation; and additions are annually made to the productive soil of the country.

The rock on which the soil of Cromarty chiefly rests, is commonly sandstone of the transition class. Compact felspar also occurs; but its connection with the sandstone has not been traced. It is said, that there are some appearances of lead ore on the estate of Brælangwell. As Cromartyshire ought properly to be considered as a part of Ross, we shall, when treating of the latter county, give a full statistical detail of both, and likewise some account of the mineralogy of this part of Scotland which has not yet been investigated. (S. K.)

CROMLECH. In various parts of the world rude and massy structures, the work of remote ages, are found; and antiquarians have been sedulously employed in endeavouring to ascertain their proper use. But as no written record of their origin is preserved, and as tradition is generally the offspring of credulity, fortified by the lapse of time, it is not an easy task to afford satisfactory explanations. The *cromlech* consists of an enormous stone, raised to some height above the earth, and resting almost invariably in an inclined position on the rudest pillars, commonly three in number.

Before speaking of the design of this ancient monument, we shall briefly describe a few of those still extant, especially in our own country, beginning with one of the most celebrated, now called Kits-Coty-House, in Kent. The stones composing it, as in the cromlech proper, are four in number; three of unequal height pitched perpendicularly in the ground, the fourth a great slab resting as an inclined plane upon them. It is of an irregular square figure, the two longest sides being above eleven feet in length, and the two shorter of about seven and a half; the whole being nearly two feet in thickness. By its inclined position, the higher part of the upper surface is more than eight feet and a half from the ground, while the opposite part is about a foot lower; and a rude cavity, or excavation, appears near the middle of the surface, capable of holding two quarts of water. Another large stone, eleven feet by seven, lies at the distance of 70 paces from the lower side on the earth. The minute particulars, which we now specify, have admitted of various conjectures, and some of them diametrically opposite, regarding the use of the cromlech. The view of this cromlech is widely commanded from the neighbouring hills. But elsewhere the situation is very different, such as one at Molfra, in Cornwall, on the summit of a round naked hill, consisting of an incumbent stone of fourteen feet three inches by nine feet eight, which rests, like the former, on three supporters, about five feet high.

An enormous cromlech, situated on a low bank of earth, apparently artificial, stands at Lanyon, in the same parish. Though nineteen feet long and forty-seven in circumference, its greatest thickness is only two feet, and its least within sixteen inches. It rests on four supporters, at such a height above the ground, "that a man can sit on horseback under it." Its general outline approaches to an ellipse, and it stands north and south, whereas the length of the former extends from east to west.

There is a cromlech in the parish of Drewsteignton, in Devonshire, of which the incumbent table-stone is fifteen feet long by ten, at the greatest length and breadth, and rests on three supporters. The highest part of the upper surface is nearly nine feet from the ground, and at a medium the whole is eight.

Similar structures are seen in Wales, both on the mainland, and in the islands. One of these, in the parish of Nevern, in the county of Pembroke, is situated amidst a great circle of stones, and consists of a stone eighteen feet long, nine broad, and three in thickness, incumbent on three others about eight feet high. In the vicinity, there is another large stone, supposed, as in the former case, to have some relation to the structure.

Rowland describes one of a singular figure in the island of Anglesea, consisting of a truncated pyramid, flat on the top, seven feet by six, and six in thickness, resting on three stones.

In Ireland there are many cromlechs, perhaps more than in most other countries, of the same kind. One at Ballymaseandlan, in the county of Lowth, consists of an incumbent stone, quite of a convex figure, 12 feet long by six in breadth, and apparently as much in thickness, supported on three pillars. Its weight is calculated at between 30 and 40 tons. Another at Castlemary, in the county of Cork, consists of an incumbent stone of greater superficial dimensions, resting on three pillars, at the height of nine feet from the ground; and near it lies a large round slab, of a similar description to those already mentioned.

At Tobins town, in the county of Carlow, there is an incumbent stone of enormous dimensions, being 23 feet long, and 18 broad at one end, on the upper surface of which is one large channel, and other smaller ones branching from it. Some persons have judged these channels natural, and others artificial; the under surface of the stone is plane and even, but the upper one is flat. This cromlech is situated in a low lying field, near a rivulet. Not far from the same spot, situated on Brown's hill, is a cromlech even of greater dimensions, supported on the east by three pillars, and forming an angle of 34° with the horizon. The height of the pillars is three feet, and the weight of the incumbent stone is estimated at above 89 tons.

On passing to the continent of Europe, different cromlechs are seen in several countries, and a structure which still exists on the coast of Syria, is supposed to be of the same description, though we cannot affirm that it is identically the same in all its parts. A natural rock nine feet high stands in the middle of an excavation of equal depth from the surface of the earth. This excavation forms three sides of a square, each of 165 feet, that to the north being open, and the whole forming a kind of court. Three stones placed on the natural rock support a fourth seventeen feet square; the top of which is about 20 feet from the ground. But those on the continent are not only very numerous in particular places, but far exceed the British and Irish cromlechs in size. Keysler describes many whose contents must be at least double or triple of those that have here come under our notice.

In considering the structures of antiquity, we find their gradual progression from the most perfect simplicity to a combination of various parts; first there is a single stone of memorial, an obelisk framed by the hands of Nature; next are two or more at intervals, and after different gradations, they appear in regular arranged circles, either for the consecration of some superstitious practice, or the commemoration of some noted event. The cromlech is a rude memorial of antiquity, but it is not the most simple; and besides those we have named single, and supported by three pillars, some appear resting upon two rows of supporters, and there are more than one cromlech in the same place. These are called double cromlechs; one of which is always of considerably smaller dimensions than the other; sometimes they are quite close together; and sometimes separated by a certain interval.

At Plas Newydd in the isle of Anglesey, there is a cromlech of this kind of large dimensions, which has originally been deposited on five supporters, though only three are standing; and close to the lower end is a smaller cromlech, in which there were originally four supporters, but one is now thrown down. Mr King has given the exact dimensions of all the stones composing this cromlech, whence we are enabled to collect, that the largest incumbent stone approaches to a triangular figure, each side being above thirteen feet; that it is five feet seven inches deep in the thickest part, and three feet in the thinnest; and that its total weight exceeds thirty tons. The incumbent stone of the smaller cromlech is quadrangular, and towards six feet square.

In various other places are double cromlechs, such as at Plasgwyn, where the interval is greater than in the former instance; and one in the shire of Merioneth, standing on a vast heap of stones, apparently collected together for this purpose. But here the larger of the two incumbent sloping slabs stretches over the edge of the other. It is supported by five flat upright stones, from five to seven feet high; and at about the distance of eight yards, is a large flat stone situated to the westward as at Kits-Coty-House. There is a great double or triple cromlech called the Hag's Bed, or the Warrior's Bed, near Castle Hyde in the county of Cork, which consists first of a huge stone, seventeen feet long by nine in breadth, and three thick, sloping to the edges, and supported by stones, of which some are six feet high; next is another lesser cromlech near it, the incumbent stone supported in the same way, its dimensions being eleven feet by seven; then is a third, the large stone of which is only seven feet square. A fourth stone, which it has been conjectured may have served as a fire hearth, lies to the westward on the ground. The double or triple cromlech is more common on the continent than here; Wormius affirms, that one is seldom to be found single in Denmark, but usually three at the same place, separated by small intervals.

There are also some cromlechs of a different structure, supposed to belong to another æra; such as a stone of a lozenge shape, resting on two pillars, on the top of a hill in the county of Down in Ireland; one 5 feet high, the other only 3. There is likewise a cromlech in the same county, supported by two rows of seven pillars.

Such are a few of the cromlechs still extant; from which it appears that there are slight varieties in the structure, but that almost all of them rest on only three supporters, and are in an inclined position. These circumstances are sufficient to prove that they are the work of man, otherwise we might be apt to consider their present site as produced by some convulsion of the earth, or that by gradual detrition, they have been allowed to remain incumbent on fragments.

It is universally maintained, that the cromlech owes its origin to a barbarous people utterly unacquainted with the arts. But difficulties of no easy solution occur respecting the modes which must have been practised to erect them; more especially when, at this day, the ablest mechanics can scarcely accomplish the conveyance of bodies extremely ponderous by land. Neither is simple conveyance the sole obstacle in the erection of a cromlech; for some stand on elevated places, and others on the summit of hills. Mr Rowland assumes, that the mode of elevating them was by forming "small aggeres or mounts of firm and solid earth upon an inclined plane, flatted and levelled at top; up the sloping sides of which they might, with great wooden levers upon fixed fulciments, and with balances at the ends of them, to receive them into proportionable weights and counterpoises, and with hands enough to guide and manage the engines; I say, they might that way, by little and little, heave and roll up those stones they intended to erect on the top of the hillock, where, laying them along, they might dig holes in that earth at the end of every stone intended for a column or supporter, the depth of which holes were to be equal to the length of the stones; and then (which was easily done) to let slip the stones into these holes straight on end; which stones, so sunk and well closed about with earth, and the tops of them appearing level to the top of the mount, on which other flat stones lay, it was only placing those incumbent flat stones upon the tops of the supporters, duly poised and fastened, and taking away the earth from between them almost to the bottom of the supporters; then there appeared what we now call our Stonehenge, Rollrick, and our cromlech, and where there are no incumbent stones, our standing columns and pillars." Nearly the same opinions have been adopted by all succeeding authors.

But an enquiry far more interesting than the mere erection of the structure itself, is the purpose for which it was designed; and on this subject the greatest diversity of sentiment prevails among the learned. The various theories, however, may chiefly be reduced to two; one contending that the cromlech is an altar for the sacrifice of human victims; the other that it is a monument marking the sepulchre of some illustrious personage; and a third, that they were designed for astronomical purposes.

The name by which these structures are presently known, afford little aid to the antiquarian. They are called the Giant's Load, the Hag's Bed, the Warrior's Bed, the Sun's Rock, King Arthur's Quoits, Kit's-Coty-House, and the like; denominations so dissimilar as not to be referable to any common or certain etymology. But we should wish to see an investigation into the real meaning of the word Cot, or Quoit, from which something might perhaps be gathered; for we have observed that this appellation is bestowed on various stones of memorial. Those, however, who maintain that the cromlech was for the immolation of mankind, find a near analogy in the Hebrew words, signifying a consecrated or devoted stone or altar.

We cannot doubt that those horrible rites, by which men invoked the favour of heaven, or divined the events of futurity, were practised here in the sacrifice of their fellow creatures: for historians bear testimony to the fact. Nay, there is a mount in Ireland, known by the name of *Killing Hill* to this day, having a structure nearly approaching to a cromlech, on the summit. In Iceland there is a stone called the Killing Stone, though we know not whether a cromlech be in the vicinity; and the remembrance of men being offered up on two pillars at Arles in France, is still preserved to posterity. But Cæsar, Tacitus, Diodorus, and Strabo, all unite in describing the immolation of human victims in these islands. The Druids were a race of priests or augurs, who bore a sovereign sway over the inhabitants; they were exclusively entrusted with the most solemn ceremonies, and could even select an individual for a victim, where those properly devoted were wanting. They are said to have passed from Britain into Gaul, where Diodorus thus speaks of their divinations. "When enquiring into any important event, a most surprising and incredible ceremony is performed by them; for having poured a libation on a human being destined for immolation, they strike him on the breast with a sword, and both from the manner of his fall, and the convulsions of his limbs, but still more from the manner of the flowing of his blood, they presage what is to happen." Tacitus, who has transmitted so much of the history of our barbarous ancestors, tells us that they were wont "to shed the blood of captives on their altars, and to consult the gods from the convulsions of men:" and Cæsar seems to insinuate that human victims were sometimes offered up in fulfilment of private vows. Long afterwards his assertions were proved in the close of the ninth century. Halfdan, a prince of Norway, was overcome by Einar, earl of Orkney, in the north of Scotland, who killed him, and cut out his lungs for a sacrifice to Odin.

Such being the case, it has been maintained by antiquarians, that no structure was equally suited for an awful and solemn purpose as the cromlech. It was formed of the rudest materials, as if in obedience to that command, which enjoins, "If thou wilt make me an altar of stone, thou shalt not build it of hewn stone; for if thou lift up thy tool upon it, thou hast polluted it." Its site was such, that a view of it might be commanded by surrounding multitudes, which was further promoted by its inclination; and this also in facilitating the flowing of the blood more readily, aided the augurs to their divinations. The cromlech, in short, was an enormous altar or scaffold whereon the chief Druid, if such was his province, could stand and perform the solemn rites of his religion before the assembled people; and the flat stone, frequently lying at a little distance, was a fire hearth, whereon could be placed a burnt offering.

The savage customs of mankind, in other parts of the world, afford too conclusive evidence, that superstition has no pity; and that it inculcates, that the blood of men will propitiate the Deity; and in accomplishing immolation, some analogies, with this apparent use of the cromlech, may be found. The sacrifice of human victims in Mexico took place on the top of lofty altars or pyramids of stone in the temples, where each priest tore out the heart as Einar did the lungs of Halfdan, and cast the body down. We believe also, that in Dahomy, the victims with whose blood the king now "waters the graves of his ancestors," are all slaughtered, and that, to the number of thousands, on scaffolds prepared for the purpose. There, as among the ancient Britons, the blood of captives is shed; and where human sacrifice is elsewhere practised, another custom, which they seem to have had of offering up criminals, or the lowest of the people, seems likewise known. Tacitus distinctly relates, that the Druids had sacred groves appropriated to their religious rites, which the Romans, in horror at their iniquity, rooted out, while they threw the celebrators into their own fires.

Wormius considers the cromlech as an altar of oblation. *Ararum structura apud nos varia est. Maxima ex parte congesto ex terra constant tumulo, in cujus summitate tria ingentia saxa, quartum illudque majus, latius ac planius sustinent fulciunt ac sustentant, ut instar mensæ tribus fulcris innixæ emineat.*

Near to Albersdorf, on the confines of Holstein, there stands a cromlech, and also one in the village of Bedel, by the river Elbe, on which it is yet customary for people to make an oblation before commencing any important undertaking.

Undoubtedly, the reasons for believing that the cromlech was an altar of sacrifice are specious; but although there are many situations where all the principles above detailed will strictly apply, there are cromlechs which, so far as probability goes, could not be adapted for that purpose. Some, in the first place, stand on the summit of lofty hills, which no multitude could surround; others are absolutely convex on the upper surface, which would effectually preclude the performance of any rites upon it. Likewise, the height of several is so far above the earth, and the highest part is so peculiarly placed, as to be extremely unfavourable for being seen from below. These circumstances have led intelligent antiquarians to conclude, that the cromlech is simply a large *kistvaen*, or rude sepulchre, composed of several stones. Human remains are frequently discovered, by digging below them, or in the vicinity; and on uncovering the place of interment, under barrows and cairns, a structure somewhat similar is occasionally discovered. The inclination also sometimes towards the east is thought "to be by way of adoration, as the person therein interred under it did when in the land of the living." But we cannot admit, that the discovery of human remains proves the cromlech to have been used as a sepulchre; for where is the spot almost throughout the world which has not been a grave? Besides, if it was an altar, these may be the remains of the victim interred beside it. More probably it is a monument of some noted event, or to the memory of one deceased. If of the latter description, it does not remount to the earliest ages, for single stones of memorial marked the site of interment. Jacob, to record the place of Rachel's sepulture, "set a pillar on her grave;" and the difficulties that must have attended the erection of such ponderous masses, could not be overcome by a people unacquainted with the mechanical arts. Many researches, however, for human remains have been ineffectually made below and in the vicinity of cromlechs, and some are in a situation which seems almost as unsuitable for covering a grave, or for being a monument, as they are for an altar of sacrifice. Were we to rest any thing on tradition, we should say that it is rather more favourable to the cromlech being a monument than an altar; and opinions are not wanting, especially that of Wormius, which seem to

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ascribe both these purposes to it. Nor is this at all improbable; for we know that, in many parts of the world, victims have been offered at the grave of one deceased, either at the moment of interment, or long subsequent to it.

We shall omit making any observations on the sentiments of those whose imagination has led them to conceive that the cromlech was erected for astronomical purposes; and who have conjectured, that one at Drewsteignton, in Devonshire, in particular, has subsisted above 2200 years. General conclusions are not to be drawn from a single example, more especially when it is altogether unsupported by the most remote semblance of evidence. Too much has possibly been said concerning the astronomical purposes of the rude monuments of antiquity extant in this country.

The erection of the cromlech, considering it as an altar of sacrifice, is, by common consent, ascribed to the Druids. But here also there is as little evidence of the fact. All that we know of the history of that singular race of priests or augurs is to be collected from meagre materials, in which no mention is made of huge altars of stone for the immolation of human victims.

On maturely weighing all that has been written on the subject of cromlechs, and taking into view their varieties in site and structure, it seems rather more probable that they have been designed as memorials of persons deceased, than for any other purpose; and that, after all remembrance of their original use was lost, or even while it was preserved, superstitious practices may have been performed upon them. See Wormius *Monumenta Danica*, p. 4. 7. 8.; Keysler *Antiquitates Septentrionales*, p. 5, 6, 7; King *Muminenta Antiqua*, v. i. p. 210; Torfæus *Historia Orcadum*, p. 19; Camden's *Britannia*, by Gough; Borlase's *Antiquities of Cornwall*, p. 223; Polwheles's *History of Cornwall*; Grose's *Antiquities of Ireland*, v. 1. introd. p. 11, 12; Rowland *Mona Antiqua*, p. 93—206; Wright's *Louthiana*, b. iii. p. 12, 13; *Archæologia*, v. 2. and 4; Maundrell's *Travels*, p. 20; Pennant's *Tour in Wales*, vol. ii.; and Smith's *Natural and Civil History of Cork*. (c)

CROMWELL, Oliver, protector of the commonwealth of England, was born in the parish of St John Huntingdon, on the 25th of April 1599. There is some obscurity, and consequent difference of opinion, respecting the condition and rank of his ancestors; but it is generally believed that his parents were in a respectable situation in life, and that he was remotely allied, on his mother's side, to the Stuart family, and descended, on the side of his father, from a sister of the favourite of the prime minister, and afterwards the victim of Henry VIII. It is certain, at least, that Oliver Cromwell, his mother, wife, and uncle, subscribed *Williams*, alias Cromwell, in the sale of the paternal estate, the former of which names they are supposed to have derived from Sir Richard Williams, Lord Cromwell's nephew, and the great-grandfather of Oliver Cromwell. This circumstance would place the paternal descent of Oliver from Thomas Cromwell beyond a doubt, were it not that he positively denied it; for when Goodman, bishop of Gloucester, who was desirous of obtaining the favour of the protector, dedicated a book to him, in which he claimed kindred to him, as being himself allied to Thomas Lord Cromwell, the protector replied, with a considerable degree of warmth, that "that Lord was not related to his family in any degree."

Of the character, disposition, talents, and behaviour of Oliver Cromwell while he was at school, there are very various and contradictory accounts. The probability is, that he was not marked, at this time, by any peculiarity to distinguish him from other boys, except by an uneasy and turbulent temper, which frequently led him into difficulties, and which kept him aloof, in a great degree, from the confidence and friendship of his school-fellows: this circumstance is well attested by authors of unsuspected veracity. He was distinguished also, according to some, in the very early periods of his life, by the same species of enthusiasm which entered so largely into his character, and contributed so materially to his success, when he engaged in public concerns. One effect and instance of this enthusiasm is very striking, and if it could be so well attested as to deserve implicit belief, it would prove that ambition as well as enthusiasm distinguished him in his youth: As he was lying, in a thoughtful and melancholy mood, on his bed, in the day time, he fancied he saw a spectre, which informed him, that he should be the greatest man in the kingdom. In the reality of this apparition, and of its prediction and promise, Cromwell persisted, notwithstanding he thus incurred the anger of his father and the chastisement of his master. It is probable that his natural temperament produced, and led him to indulge, in these fits of fancy, and that afterwards, when he perceived how greatly they might conduce to the high and difficult objects he had in contemplation and in hope, he pretended to be subject to them even after the strength of his mind and of his constitution had thrown them off.

On the 23d of April 1616, he was admitted a fellow commoner of Sidney College, Cambridge, where he paid more attention, and gave up more of his time, to football, cricket, and other manly and vigorous exercises, in which he was wonderfully skilful and expert, than to his studies. When he had been about two years at college, he was recalled home by the death of his father. At home he became excessively dissolute and licentious, which gave so much uneasiness to his mother, that she sent him to London, where he was entered at Lincoln's Inn. As he had discovered no predilection for the law, and his habits of idleness and irregularity were rather increased than diminished, by the temptations to which he was exposed in the metropolis, this scheme for reforming him seems to have been ill-advised. His licentiousness was now very gross, as well as constant. Almost the whole of his time was spent in the company of women of the most low and abandoned characters, in drunkenness and infamy. In consequence of this mode of life, the property which his father had left him, was speedily dissipated. Notwithstanding the profligacy of his character, and the desperate state of his affairs, he paid his addresses to Elizabeth, daughter of Sir James Bouchier of Essex, and by the interest of his relations Hampden, Harrington and Stewart, he obtained her in marriage, when he was scarcely twenty-one years of age.

Soon after his marriage, he returned to Huntingdon, and passed suddenly, and at once, from a dissolute and licentious, to a grave and sober life. This change, so striking, complete, and sudden, has not been satisfactorily accounted for; had it been to the extreme of enthusiastic devotion, it could not have appeared uncommon, but there is good reason for believing, that when it took place, he was not connected with the Puritans, but retained his belief in the doctrines and discipline of the church of England. Not long after his return to his native place, an estate of about £400 a year, situated in the Isle of Ely, which devolved to him by the death of his uncle, Sir Thomas Stewart, induced

Cromwell. him to settle in that part of Cambridgeshire. At this time, and in this place, he first became acquainted with the Puritans, and, in consequence of his connection with them, deserted the established church, and assumed, or experienced, that tone of feeling by which they were distinguished.

Soon after this change in his sentiments, he was elected a member of the third parliament of Charles I. which assembled on the 20th of January 1628. He was appointed one of the committee, who were empowered and instructed by the House to inquire into matters connected with religion; and distinguished himself by his zeal against Popery. On the dissolution of this Parliament, he retired into the country, where he wasted his estate by his negligence and inattention, his whole time and thoughts being occupied with the concerns of religion, and of the silenced ministers. At last his circumstances became so desperate, that he determined to leave the country, and to settle with his family in New England. This scheme he would undoubtedly have carried into effect, but in consequence of the great numbers whom the unsettled state of affairs, and the persecution of Puritanical tenets, induced to emigrate, a proclamation was issued to restrain such embarkations. His mind and feelings seem to have been very restless at this period; and having no other proper and sufficient object, on which to display and exert themselves, he set himself in opposition to the Duke of Bedford, and some other persons of high rank, who were desirous of draining the fen-country. Strong popular objections were urged against this scheme, and Cromwell joining in the opposition to it with great activity, vigilance, and zeal, his character and talents became better known in the country, and his influence and authority consequently extended and increased. His conduct on this occasion, indeed, was so conspicuous and remarkable, that Hampden afterwards expressly referred to, and cited it in Parliament, as a proof that he was a person capable of contriving and conducting great things.

But his character was established now, not only as a man of considerable vigour and activity of mind, but as one richly endowed with the gifts of praying, preaching, and expounding the scriptures; and to the fame which he had acquired on this account, he was principally indebted for his second election to parliament. He resolved to offer himself for Cambridge, but as he not only possessed no interest or friends there, but was not even known to the electors, it was necessary to have recourse to intrigue and stratagem, which were carried on with great adroitness and complete success. Before he could become a candidate, it was indispensible that he should acquire the freedom of Cambridge; and this he obtained by means of some of those to whom he had recommended himself by his spiritual gifts; they had influence with the mayor of Cambridge, and they represented Cromwell to him as a royalist and a gentleman of fortune. As soon as he had succeeded in obtaining the freedom, his election was secure, for the Puritanical party among the burgesses was by far the most powerful and numerous.

He spoke frequently in this parliament; but his speeches were distinguished more by the warmth and impetuosity with which they were delivered, than by arrangement of thought, perspicuity of language, or gracefulness of manner. It was, however, easy to perceive, in the midst of his perplexed and wandering periods, that his conception of the subject of debate was strong, steady, and original. He was at this time very inattentive to his dress. During one of the debates, Cromwell. Lord Digby observed him, and pointed him out to Hampden, "Pray," said he, "who is that man, for I see that he is on our side, by his speaking so warmly to-day?" "That sloven," replied Hampden, "whom you see before us, who has no ornament in his speech; —that sloven, I say, if we should ever come to a breach with the king; which God forbid! in such a case, I say, that sloven will be the greatest man in England." The remonstrance, which was passed in November 1641, and which may justly be regarded as the immediate cause of the civil war, was ably and warmly supported by Cromwell. By his conduct on this occasion, he so effectually recommended himself to Pym and Hampden, that he was admitted into their councils, and informed of their designs. In the beginning of 1642, the parliament resolved to raise an army; Cromwell immediately went down to Cambridge, where he raised a troop of horse, of which he was appointed commander. He was now in his 43d year, yet in the space of a few months he not only became an excellent officer, but had disciplined his troops so completely, that they were justly regarded as equal to regular and experienced soldiers.

It is foreign to the nature and design of the present article, to enter into a detail of the military exploits of Cromwell; these more properly belong to the province of history. The actions in which he principally distinguished himself, may, however, be briefly noticed. In the battle of Marston Moor, which changed the fortune of the war, the independents ascribed the victory to Cromwell's iron brigade; though Hollis and other writers accuse him of cowardice, in retiring from the field on account of a slight wound: this he probably did, but the charge cannot be rested on this circumstance. "Cæsar and Cromwell," observes Walpole, "are not answerable to a commission of oyer and terminer." In the second battle of Newberry, he made so bold a charge with his horse upon the guards, that his Majesty would have been in the greatest danger, had not the Earl of Cleveland preserved his master's liberty at the expence of his own. When the self-denying ordnance was passed, Cromwell was at first occasionally, and afterwards absolutely and perpetually, exempted, and appointed lieutenant-general of the army. In the battle of Naseby, 1646, he particularly distinguished himself. Fortune for some time favoured the cause of royalty; Skippon's division was disordered and driven behind the reserve; but the battle was restored by Fairfax, and the royalists had already began to waver, when they were attacked in flank and rear by Cromwell, and the confusion became irretrievable.

As soon as the king had delivered himself up to the Scots, the parliament resolved to disband part of their forces. If this resolution had been carried into effect, the designs and the hopes of Cromwell would have been overthrown; and yet he could not oppose it openly and directly; he therefore had recourse to those secret and cautious measures, in the planning and execution of which he so much excelled, wherein he was the sole agent, though he did not appear to act, or even to take any interest. Perhaps in no one instance did he succeed so completely in the object he had in view, as in this; for he managed so, that those troops on which the parliament might have depended, and of which he was jealous or afraid, were disbanded, while the army of Fairfax, over whom he possessed, in fact, the sole power, was permitted to continue on its full and regular establishment. Being now possessed of willing and adequate instruments for the prosecution of his ambitious purpose, he seized on the person of the king; and having got him into his power, he *played off* the king, parliament, and army, against one another. The king was completely deceived in his character and designs; the parliament, trusting rather to his professions of obedience and respect to them than to his actions, was equally deceived; and the army were ready to follow the man, who, when the parliament were obliged to erase their own declaration respecting them out of their journals, assured them that "now they might be an army as long as they lived." As soon as the parliament discovered the real character and designs of Cromwell, they endeavoured to crush him; but he had now gained such a powerful influence with the army, that they compelled it to acquiesce in all that he did; and, in December 1648, they took forcible possession of the House of Commons.

When it was first proposed to try the king, Cromwell declared, that "if any man moved this upon design, he should think him the greatest traitor in the world; but since Providence and necessity had cast them upon it, he should pray God to bless their counsels, though he was not provided on the sudden to give them counsel." Shortly afterwards, however, he pretended, that as he was praying for a blessing from God on his undertaking to restore the king to his former state and power, his tongue cleaved to the roof of his mouth, that he could not speak one word more, which he took as a return of prayer that God had rejected him from being king. Within a very few days after the king's death, Cromwell became a principal member in the council of state, in whose hands the executive power was placed. He seemed now near the grand object of his ambition, when a circumstance occurred which threatened to snatch it from him by those very means which he had employed to gain it. Part of the army which he commanded being dissatisfied, sent a remonstrance to their general; the ringleaders were seized and punished in an ignominious manner, but the mutiny and dissatisfaction spread, and Cromwell's own regiment put white cockades in their hats, and fixed on *Wales* as the place of their assembling. In this critical emergency, the promptitude, decision, and personal bravery for which he was distinguished, were absolutely necessary—nor were they wanting; with two regiments of horse he surrounded the mutineers, and calling out four men by name, he obliged them to throw dice for their lives, and the two that escaped were ordered to shoot the others.

In 1649, England being quiet, and the Scotch intimidated, though discontented, Cromwell embarked with his army for Ireland, and, in less than twelve months, the whole of that island was subdued. During his absence, the Scotch recovered their courage, invited Charles II. and prepared to invade England. To repel this invasion was the duty of Fairfax, but Fairfax had taken the covenants, and would not fight against the Scotch. Cromwell therefore was appointed general and commander-in-chief, and in conformity to one of his military maxims, that one invasion ought to be prevented by another, he marched into Scotland. Ignorant of the nature of the country, or of the face and situation of the Scotch armies, his supplies were cut off in the neighbourhood of Dunbar; his troops became sickly, and his retreat was intercepted. Had the Scotch general continued in his position on the heights, the English army must have surrendered; but his operations were controlled or impeded by a committee of church and state, who blamed him for his reluctance to extirpate the sectaries. Goaded by these reproaches, and in obedience to their peremptory orders, the commander of the Scotch army quitted the hills, saved the army of Cromwell, and ruined his own. At the moment when the Scotch were making this disastrous movement, Cromwell and his officers were engaged in a solemn fast; when he perceived it, he exclaimed, "They are coming down, the Lord hath delivered them into our hands!" In 1651, he gained the battle of Worcester, which, in his letter to the parliament, he styled the "crowning victory." From this time he assumed more loftiness of manner, and betrayed less equivocal symptoms than usual, of his designs and his hopes. Before, however, he could expect to succeed, it was necessary to subvert the parliament; and on this point, disguised under the idea and phrase of establishing the kingdom, he had frequent conferences with the most eminent and leading men in the nation, and particularly with the Lord Commissioner Whitlocke. He soon found that it was absolutely necessary to proceed with great caution and deliberation; the parliament were alarmed and put on their guard, and they framed a bill to continue their sittings till the 5th of November 1654. Cromwell being informed of this proposed measure, marched to Westminster with a party of 300 soldiers, whom he placed round the House. He himself went in, and listened to their debates for some time in silence, till the question being put for passing the bill, he rose and abused the members in the most violent and gross terms, and when some of them began to speak, he stepped into the middle of the House, and exclaimed, "Come, come, I will put an end to your prating;—you are no parliament, I say you are no parliament!" he then gave the signal, by stamping with his foot, for the soldiers to rush in, and bade one of them take away that bauble, pointing to the speaker's mace. The soldiers next cleared the House of all the members, and the doors were locked up. Having thus forcibly dissolved the parliament, he treated the council of state in the same manner.

On the 16th of December 165[illegible], he was solemnly invested with the office of Protector of the commonwealth of England, Scotland, and Ireland, in the court of chancery, in Westminster Hall; and he lost no time in directing his thoughts to the arrangement and settlement of public affairs, both foreign and domestic. Abroad he was feared, and made the rights of England respected. At home his administration of justice was pure and impartial; the courts were filled with able judges, and the practice of the law was freed from many imperfections and abuses. He declared his unalterable resolution to maintain liberty of conscience, and in his conduct he adhered to this resolution.

Notwithstanding he thus endeavoured to gain popularity and stability to his government, discontent prevailed; he found himself under great difficulties for want of money, and he was at last obliged to call a parliament. The superstitious cast of his mind displayed itself on this occasion; he fixed the third of September for the day on which the parliament was to assemble, esteeming it particularly fortunate to him, and on that day, though it happened to be a Sunday, the parliament met. It was, however, soon dissolved, for finding that they wished to take away his authority, and were not disposed to vote him any money, he sent for them into the painted chamber, and, after a long and bitter speech, dismissed them.

This violent proceeding increased the discontent and dissatisfaction of the nation, and several conspiracies against his life or authority were set on foot; but he discovered them all before they were ripe for execution. His want of money was partly, and for a time, supplied by the spoil which Blake collected during the Spanish war; but this being exhausted, he again summoned a parliament, having, as he conceived, taken such measures as would make them more obedient to his will than the last parliament had been. It is probable, however, that the members of this parliament would have been stubborn and unruly, had they all been permitted to assemble; but a guard was placed at the door of the House, who permitted none to enter till they had taken the oath prescribed by Cromwell. In this packed parliament an attempt was made to give him the title of *king*; but a petition from the army being prepared against it, Cromwell thought it prudent to refuse the honour, and to content himself with his former title of protector. In 1658 he was excessively alarmed by the publication of the celebrated tract, entitled "Killing no murder," the object of which was to prove, that one who had violated all laws, ought to derive protection from no law. This treatise was written by Colonel Titus, under the name of William Allen. Cromwell made many attempts to discover the real author, but in vain.

About this time he formed a project fer creating a House of Lords, and actually summoned his two sons, and some others, to take their seats in it; but when the parliament assembled, none of the old nobility made their appearance; the House of Commons would not act with the new nobles; and the new nobles could not act by themselves.

The strength of his body and mind now began to sink under his disappointments and apprehensions; he was haunted by continual terror; his own soldiers threw off their attachment and awe; his conscience was awakened by the death of his favourite daughter, who, in her delirium, upbraided him for his tyranny and cruelty; and even his wife united herself with the republican party. He knew not whom to believe or trust; he constantly wore concealed armour, and never went abroad, unless surrounded by guards, whom he suspected nearly as much as those against whom it was their office to have protected him; he never returned by the same road, nor slept thrice in the same apartment. It was utterly impossible that his constitution, already broken up, should long stand against this incessant and increasing agitation of mind; he was seized with a slow fever, which, changing into a tertian ague, soon threatened his life. His physicians informed him of his danger, but his courtly or fanatical chaplains assured him that their prayers would still be efficacious to restore him. When he was first taken ill he was at Hampton court; but on his illness becoming alarming, he was removed to London, when he first became lethargic, and then delirious; still, however, retaining in the short intervals of reason his original enthusiasm, vehemently declaring that his life was conceded to the faithful, to intercede with God as a mediator for the people. Immediately before his death, he was asked if he did not name Richard his eldest son for his successor, and to this question, which it is probable he did not understand, he answered in the affirmative. He died on the 3d of September 1658, being rather more than 59 years old.

The features in the character of Cromwell are strongly marked; his spirit was bold and enterprising, his personal courage undoubted; his promptitude and presence of mind never forsook him in the most sudden and unexpected emergencies. Whatever object he had in view, he pursued with unabated zeal and perseverance; he examined it thoroughly, made himself acquainted with the obstacles with which it was surrounded, and the means by which it might be attained; and with this information, he united the most consummate address, and such a profound sagacity in discerning the characters and designs of others, as enabled him to employ them in the furtherance of his own plans. But while he penetrated into the characters and designs of others, he threw an impenetrable secrecy over his own; even his natural enthusiasm, which it might have been supposed would have laid open his plans in the moments of its extravagance, was so curbed and disciplined by his hypocrisy, that it served the same purpose with him, which dissimilation and reserve are supposed exclusively to answer. But after he became possessed of the supreme power, he seldom stooped to obtain that by artifice which he could acquire by authority or fear; it was more agreeable and consonant to his disposition and temper to command than to deceive. His military reputation has been raised higher than a due estimation of his talents will warrant; his military talents were certainly not of the highest order or the rarest kind; they did not display themselves in the plan or conduct of a campaign, nor even in extensive combinations or masterly evolutions in the field, but rather in the enthusiam with which he inspired his troops, and in the discipline which enabled him to reap all the advantages, while he avoided the ill consequences of that enthusiasm. His talents as a statesman were of the same kind and degree; his government was founded on no exclusive or profound plan of policy, but arose out of circumstances, or was decided by them.

He had many children, six of whom lived to an advanced age. Richard, his eldest son, was naturally of a quiet and unambitious temper, of very moderate talents, and from the retired and indolent life which his father directed or permitted him to spend, wholly without experience or knowledge of the world. He succeeded nominally to the sovereign authority; and while he continued to govern without a parliament his power was respected, but as soon as he summoned it he was assailed by secret enemies and by open force, and in a very short time degraded by the army; he cheerfully laid aside his authority, and passed from the throne to a private station, in which he lived unnoticed and almost forgotten, till the 13th of July 1712, when he died at Cheshunt in Hertfordshire. See Harris' *Life of Cromwell*; Noble's *History of the Cromwells*; *Biographia Britannica*. (W. S.)

CRONBERG. See Elsineur.

CRONSTADT, or Kronstadt, a sea-port town of Russia in the government of Petersburgh, situated at the south-eastern extremity of the island Retusari, in the gulf of Finland, which is a long stripe of sandy ground traversed by ridges of granite. This island is about 5 miles long and $\frac{3}{4}$ths of a mile broad, and was covered with firs and pines when it was taken from the Swedes by Peter. It now grows a small number of birch trees, and affords a small quantity of pasture and vegetables.

Cronstadt is defended towards the sea by fortifications of granite projecting into the water, and towards the land by ramparts and bastions. Several of these were erected by Catharine; and Paul I. established a new bastion, called Ries-bank, to the south-east, opposite to Oranienbaum. The houses fronting the harbour are built of brick and stuccoed white, and the lofty and spacious magazines inspire a stranger with a high notion of the place; but this exaggerated opinion is soon corrected, when he observes the mean appearance of the houses, which are principally of wood, and are scattered up and down with little regularity.

The principal public buildings are the imperial hospital for sailors, the hospital for the town's people, and the barracks, the marine academy for cadets having been removed by Catharine II. The hospital, which is on a very large scale, contained 25,007 patients in 1788, of whom 20,924 were cured; and in 1789 the number was 16,809, of whom 12,974 were cured.

The numerous vessels which frequent this town are accommodated by three separate harbours. The eastern harbour contained 20 ships of the line and 9 frigates in the year 1778; the middle harbour is intended for frigates, sloops of war, and yachts belonging to government; and the western harbour, which is appropriated for merchant ships, can hold 600 vessels. Adjoining to it is Peter's canal, which was begun in 1719 by Peter the Great. In the same year he founded the dry docks for building and careening ships of war, but they were not completed until the reign of Elizabeth, and they have received considerable improvements from Catharine. At the extremity of these docks there is a vast bason of granite 568 feet long, containing water for the supply of the docks, which is pumped into them by a steam engine whose cylinder is 6 feet diameter, erected by the Carron Company of Scotland in 1772. The docks, which can hold 10 men of war, are faced with stone and paved with granite, and are 40 feet deep and 105 broad. The whole length of these works is 4221 feet. The dock-yards are supplied with oak from the province of Cara; and there is at Cronstadt a foundery for casting cannon, and a rope-work for manufacturing cables of all kinds.

Some idea of the trade of Cronstadt may be formed from the following Tables:

Table shewing the Number of Merchant Ships that have arrived annually at Cronstadt from England from 1753 to 1778.

	Ships.		Ships.		Ships.
1753, ...	149	1760, ...	137	1770, ...	306
1754, ...	236	1761, ...	130	1773, ...	319
1755, ...	169	1762, ...	153	1774, ...	318
1756, ...	186	1763, ...	149	1776, ...	320
1757, ...	129	1767, ...	200	1777, ...	366
1758, ...	161	1768, ...	277	1778, ...	252
1759, ...	206	1769, ...	322		

The following vessels arrived at Cronstadt in 1778.

	Ships.		Ships.		Ships.
English, . .	252	Dutch, . . .	147	Hamburgh, .	2
French, . . .	1	Spanish, . .	39	Stralsund, . .	1
Spanish, . . .	6	Russian, . .	26	Bremen, . . .	3
Russian, . . .	12	Lubeck, . .	38		
Portuguese, .	2	Rostock, . .	29	Total, . .	607
Swedish, . .	47	Dantzick, . .	2		

The population of Cronstadt is generally estimated at 30,000, the greater part of whom belong to the fleet and the garrison. The number of registered burghers does not exceed 300. See Tooke's *View of the Russian Empire;* Storch's *Picture of St Petersburgh;* Coxe's *Travels in Poland,* &c. vol. iii. p. 283, 307. 5th Edit.; and Catteau Calleville *Tableau de la Mere Baltique,* vol. ii. p. 309, 351. (π)

CROOKS, in Music, are appendages to the trumpet, French-horn, and trombone, consisting of short tubes of brass of different lengths, that fix on below the mouth-piece, for lengthening or shortening the tube by changing them, in order either to tune these instruments to the pitch of the organ or piano-forte, on which the conductor is to perform at the commencement of a concert or performance, or for changing the fundamental tone after such adjustment of the pitch, or the key in which the instrument is capable of performing, if it has not a sliding movement or other contrivance for obviating the necessity of this latter use of crooks. See CHROMATIC FRENCH HORN, TRUMPET, and TROMBONE. (ϱ)

CROPS. See AGRICULTURE.

CROSS. See CRUCIFIXION.

CROSS TEXTURE, in the manufacture of cloth, is a species of weaving in most cases applicable chiefly to those fabrics in which transparency is the principal quality, and hence very few kinds of it are used for any other than ornamental purposes. Its origin, as far as we know, is continental, although, like most other fabrics, the knowledge of it may very likely have originated in Asia. One particular fact relative to it may perhaps strengthen this conjecture, and that is the texture of the common Russian table rubber. Although the fabric of these rubbers is of the coarsest flaxen or hempen yarn, and they are sold at very low prices, the mode of weaving them is to this day unknown to the rest of Europe; and although machinery which would effect them might be devised by a person skilled in mechanical knowledge, and previously conversant with the other kinds of crossed texture in use, yet the apparatus which he must employ for an imitation of this coarse article, if conducted upon principles in any respect similar to those of other cross fabrics, would probably be more expensive than what we use for the richest silken nets.

In the absence of better and more authentic information upon the subject, some conjectures upon the means of effecting this manufacture in the most simple way, will form some part of the conclusion of this article. At present, the only remark which is drawn from the notice now taken of it is this, that the small progress which arts and sciences have hitherto made in Russia comparatively with the rest of Europe, and the existence of one of the most complicated and difficult processes of an ornamental manufacture in such a country, afford sufficient reasons to doubt the originality of its invention there. The contiguity of the Russian empire to those regions of Asia from whence the other branches of the manufacture found their way into Italy, seem to warrant the presumption, that while they found their way to the west, this particular one had by some accident diverged to the north, and established itself in a rude state among the Muscovites.

The generic distinction of this branch from all the others, consists in the twining or crossing of the warp, and hence it combines the strength of mechanical union with a greater degree of lightness and transparency than any other fabric of cloth. The common linau or gauze is the ground-work or basis of all the varieties, and its texture consists in twining two contiguous threads of warp alternately to the right and left during the operation of weaving. The figures, illustrative of the mechanical part of the operation of forming this texture, which, with a single exception, has never been discussed through the medium of the press, will be found in Plate CCXIX., which contains eight illustrations, two Figures being devoted to each species; the first exhibiting it in its open state, or in that which assimilates it to the common principles of texture; the second in that crossed or twined state which constitutes its generic peculiarity.

Plate. CCXIX. Figs. 1, 2.

The common linau, or gauze loom, is exhibited in profile elevation in Figs. 1. and 2. The posts of the loom, of which two are visible, are distinguished by AA, and the connecting cross rail, or cape, by BB. The roller, or beam, upon which the warp is rolled, appears at C; and the balance weights, by which the tension of the warp is preserved, are at D. The receiving roller, upon which the cloth is wound when woven, is at E; the heddles are at F, and the treddles, or moving levers, are below at G. In Fig. 1. the treddle is represented as having its centre of motion nearly under the weaver's feet, as is customary in most species of light texture. In Fig 2. the centre of motion is reversed, so that the pressure of the foot may operate on the extremity of the lever to increase the mechanical power. In crossed textures the latter is the most advantageous way of applying the power; for although the warp itself be light, and such as would oppose little resistance to the power of rising and sinking in parallel lines, the physical resistance which the cross rings oppose to the moving power, requires a great additional impulse to overcome it. The reversed treddles, therefore, are commonly adopted with evident propriety.

The heddles being the part of the apparatus by which the necessary motions are communicated to the warp, upon their construction depends all the varieties of texture, and those employed for crossing being very different from all others, it becomes an object of the first importance to every person who wishes to acquire a competent knowledge of this branch of the art, either theoretically or practically, to be well acquainted with the nature of their construction. In general, for the coarser kinds of cross weaving, the common linked or clasped heddle is employed; and the difference consists in no alteration of the heddle itself, but in the way in which the warp is drawn through it, and the addition which it is necessary to make, in order to fit it for the special end to which it is to be applied. In some kinds the heddles are made with eyes knotted in them; and where the friction is very great, in consequence of the crossings, perforated beads of smooth round glass are used, both for convenience and durability. Besides the heddle, a second apparatus similar to it is used; and this, whether with or without a bead, receives and conducts the warp thread in its various crossings. In the most common kinds of linau and catgut, it is merely one half, or one link of the common clasped heddle, and is stretched upon a single shaft of wood. These, in the figures, are distinguished by the numerals 1 and 2. By inspection it will be seen that the linau, or gauze mounting, consists of four leaves of complete heddles, marked F, and called standards, and the half leaves 1 and 2. The warp of a gauze is not drawn between the links as in common weaving, so that it may be either raised or sunk, but above or below the clasp, so that the motion of the heddle affects it only in one direction. Thus the thread which is above may be raised, but cannot be sunk by the heddle through which it is drawn, and, *vice versa*, the same takes place with that which is drawn below the clasp. These heddles, or standards, are distinguished by the numerals 3, 4, 5, 6, in both figures. In the standards 3 and 4, which are in front, the warp does not pass at all through any part of the standard, but the half leaf 1 passes above the clasp through each heddle of the standard 3, and through this half heddle the warp thread is drawn. As this half leaf rises independently of the standard, but never sinks unless in conjunction with it, the shaft is below and in front of both standards. The motion of the half leaf 2 being exactly the reverse of the former, the shaft is placed above. Between the standards 3, 4, and the leaves 5, 6, a greater distance is allowed than could conveniently take place in the figure, and here the two threads of warp, which are contiguous, are crossed over each other, instead of being drawn parallel as in other kinds of weaving, that to the left hand being generally above, and that to the right hand below, although this is merely the common form for the sake of convenience, for the order of every part might be inverted, and the same effect would still be produced. When the half leaves are raised and sunk, the warp is parallel like that of common weaving, excepting the cross which takes place between the standards, and when they are kept tight the warp is twisted like a rope. It will be apparent by an attentive inspection of Fig. 1. that the front standard or leaf 3 is sunk, and the half leaf raised to admit the warp thread between the half heddle or *lam* and the standard, and that the reverse takes place with the standard 4, which is raised, the half heddle 2 being sunk. These standards and half heddles in this case communicate no motion to the warp, but merely yield to it, or rather are removed to prevent them from opposing any impediment or resistance. The whole effect upon the warp is here produced by the raising of the back leaf 5, and by the sinking of the back leaf 6. The effect therefore is exactly that of a plain warp operated upon by two leaves of heddles; for the warp is open entirely back to the rods at 7. This may in one sense be called the open *shed*, and in another the cross; for when viewed in a perpendicular direction, as in the figure, all the warp appears open to the eye, although it is really horizontally crossed between the leaves 5, 6, and the standards 3, 4. Thus the leaves 5 and 6 produce the whole motion in this figure, and the reversed and twisted motion will immediately appear by an examination of Fig 2. Here the former motion is completely inverted, and the back leaves 5 and 6 have, in this instance, nothing to do but to preserve the cross given by the mode of drawing the warp. They therefore remain stationary and inactive, while the whole operation is performed by the mounting in front. The cross upon the warp now becomes apparent between 4 and 5, and the whole motion is given by the half leaves or lams 1 and 2, and by the standards 3 and 4. The lams and standards do not now yield in opposite directions, but the lams being pulled tight, the standards act merely like common heddles. The lams no longer yielding to receive the thread between them and the standard, the threads must rise on the opposite side from what they did before, and the same standards being still raised and sunk, one complete twist or revolution of the warp is effected. When this has been secured by the insertion of a thread of woof, the warp reverting to its former state, at the next operation, again twists the threads in the opposite direction, and so on alternately, so long as the texture continues.

Plate CCXIX. Fig. 2.

It is often considered to be useful, occasionally, to intersperse plain parallel woven cloth with the linau. To effect this it is merely necessary to add a third treddle, to reverse the standards without slackening the lams. In this case the standard 4 sinks, the standard 3 rises, and the lams retaining their tension, plain parallel woven cloth is produced, the twist behind and the back leaves 5 and 6 remaining stationary and unmoved. The tension of the lams is produced by hanging small weights on the marches which give motion to them, and connecting these weights with the other marches which move in an opposite direction when they are to be lifted. As the marches are long and short, as in the other kinds of ornamental weaving, the application of the weights is a matter of the utmost facility after the loom is mounted.

Plate CCXIX. Fig. 3, 4.

The Figs. 3 and 4 represent the machinery of crossed texture, where the twist is carried one half further than in common linau or gauze. In this species of cloth, which is called catgut, one revolution and a half is in each twining, and therefore the threads are alternately raised and sunk in the twining and untwining. The stuff commonly employed in the texture of catgut is linen thread, and it is used for stiffening those parts of female dress where transparency is required, as buckram is used for the same purpose in men's clothes. The open *shed* is represented in Fig. 3, and the same letters express the same parts of the loom as in the other figures. The mounting, it will be observed, consists of only three leaves and one lam. Indeed, the coarser kinds may be, and frequently are, wrought simply with two leaves of heddles, and a set of lams hung from a shaft above, without any leaf or standard whatever. In the open state, Fig. 3, the shed is formed by raising the leaf 3, and sinking the leaf 4; the standard 2, under the clasp of which the lam passes, remaining stationary, and the lams slack, as represented in the figure. It then passes round the lower thread, and allows the upper to rise. The reverse shed is represented in Fig. 4. Here the lam being tightened, and the back leaves raised a little, the common gauze twist would be given without further apparatus; but when this is effected, the front standard 2, by sinking, gives the additional half-crossing, and thus all that was required is produced. This being merely a small addition to the general principle of gauze, it is presumed that a tolerably correct conception of it may be formed without the necessity of a more detailed explanation. It will therefore be best to proceed to some explanation of the most common species of loom net-work, for which purpose three have been selected as specimens. The variety is unbounded; but of all the nets in common use, the whole are little else than small additions to, or alterations of, the principle of the first represented by Figs. 5 and 6; and the last, which is called the patent net, though we believe without any just reason, partly because it is one of the most complicated, and also because it is the only one of real British origin, having been invented at Paisley, where it is known by the name of the *night thought*, a name probably bestowed upon it from the nocturnal meditation which it cost the inventor.

Fig. 5, 6.

As the crossings of this last net are very complex, we have only been able to give a general idea of them, which will be sufficient, however, to elucidate the principle to one conversant with the general subject, and even enable any person, with a little care, to form a general idea of its nature. The Figs. 5. and 6. containing the principles of a net which, in combination with the gauze already described, forms the basis of almost every variety in common use, is entitled to a more ample explanation, although it cannot be expected, that this can be rendered sufficiently diffuse to comprehend all that might be practically useful.

The mounting of nets is in so far different from every other kind of weaving whatever, that to effect the purpose, it is necessary that a considerable part of the apparatus should be placed in front of the reed, and should move along with the oscillatory vibration of the lay which contains it. The Figures 5. and 6. are transverse elevations of a loom taken in the front, behind the place where the weaver sits. It may also be proper, in order to prevent the possibility of misconception, to observe, that the heddles are drawn upon a scale vastly greater than their relative dimensions to the size of the loom would warrant. But as the object of the Figure is to elucidate the nature of their construction, this inaccuracy was unavoidable, unless the whole Figure had been drawn upon a very large scale. The reader, however, may avail himself of this caution, that what appears in the Figure to occupy the whole breadth of a loom, does not in actual practice contain much more than the eighth part of an inch, and that the whole breadth is composed of successive repetitions of the same objects. This mode of drawing appeared indispensible, in order to convey a definite idea of the crossings, without enlarging the whole figure to an inconvenient or perhaps impracticable size. Taking Figs. 5. and 6. as transverse elevations of the front of two looms, the fore part of all the apparatus for moving the heddles becomes distinctly visible, and the arrangement of the levers, next to that of the crossings, is the most essential point in which the construction of net looms differs from those adapted for other kinds of fanciful loom-work. Although the distinguishing letters have been applied as nearly as possible to the same parts as formerly, yet as this elevation exhibits the loom in a different point of view, it may be proper to recapitulate the whole, which are as follow: AA the two upright posts which are visible; BB the ends of the upper rails or caps; C, D, E and G are not visible in this view of the loom; F shews the heddles, the front or under *lams* being distinguished by the numerals 1. 1. &c. and the upper or back *lams* by the numerals 2. 2. &c. At H is the front top lever, the others being behind; I and K are the long and short marches, entirely the same in construction with those of other fancy looms, their centres of motion being at L; and, as usual, the short set sinking the leaves by direct communication with the lower shaft, and the long ones raising them by connection with the top levers. The crossings are effected by the mode in which every thread of warp is conducted through the heddles; and this we shall endeavour to render as explicit as possible, although this will be difficult without additional plans. The first crossing is effected exactly as in common gauze, by crossing the two threads which pass through the same interval of the reed; and this takes place when the lams are slack, the crossing being effected by the leaves behind the reed. But as the same threads are not again to cross each other, which would produce plain gauze, the next crossing is effected upon threads contiguous indeed to each other, but placed in different intervals. Thus, if we suppose eight contiguous threads occupying four intervals of the reed to be expressed by the letters AB, CD, EF, GH, the first or gauze crossing may be pretty well understood by the punctuation, A and B being crossed together, CD the same, and so on. Now, this being the first crossing, the second in order, to form a diamond, must stand thus, A, BC, DE, FG, H. This makes it apparent that the diamond is formed; and if we suppose a great series expressed by the same letters, AH will link together like

Plate CCXIX. Figs. 5, 6.

Plate CCXIX. Figs. 5, 6.

the rest, for A will be linked with H of the preceding series, and H with A of the succeeding one. To illustrate this, the letters *abcdefgh* are added to the Figures, and what is termed low-case letters are used to prevent their being confounded with the capitals, which distinguish other parts of the loom. The first mode of punctuation is that produced by the apparatus when in the state represented by Fig. 5. and the second that which it assumes in Fig. 6. From even this cursory description, an attentive examination may satisfy the reader that this apparatus is merely an alteration of the disposition of that of common linau or gauze. The alteration is effected by crossing alternate threads instead of twisting and untwisting the same in rotation. The appearance of the net when finished is a diamond exactly like a common fishing net, and it is represented in Plate CXCIII. illustrative of the geometrical principles of texture attached to the article CLOTH *Manufacture*. In that Plate is also given a representation of what is termed the mail net, which is merely a combination of this net with common gauze. The reader may perhaps be enabled to form some conception of the mounting of the mail net, especially if he be in any respect conversant with the general principles of texture, by supposing it to be merely a double set of gauze mounting, made to work alternately the gauze and net parts. Referring to Figs. 1. and 2. of this Plate, and combining the apparatus represented there with that in Figs. 5. and 6. will also be of service to aid him. Let him suppose Fig. 1. to contain two warps, entirely separate and distinct from each other, and rolled on separate rollers or beams. Let that comprehending the gauze part be represented, as before, rolled on the beam C, and that which composes the whip upon the additional beam N, placed below, and represented by a dotted circle. The two warps being thus kept entirely distinct, that which is below may be slackened whenever the crossing of the whip becomes necessary, without at all affecting the gauze warp upon the beam above, which retains its tension while the other is slackened to admit of the crossing. The number of leaves must be precisely doubled, one set being allowed for the warp on each beam, and the disposition of these leaves is as follows: To the back leaves, 5 and 6, are added two other back leaves exactly similar to those represented. Of these four back leaves, two contain the gauze and two the whip part. In front of these are two standards, with lams exactly, as represented at 3 and 4, these complete the gauze part. The reed comes next, and through it are drawn two threads of each warp alternately. In front of the reed come the additional standards and lams for the whip part, and these are exactly similar to the former. The profile view in Figs. 1. and 2. repeated, gives that view of them, and the front view is the same as in Figs. 5. 6. The appearance of the net when woven is given in Plate CXCIII. attached to the article CLOTH *Manufacture* already quoted, and is the same as that exhibited in Fig. 8. were all the squares filled with diagonal lines. The slackening of the lower beam is effected by the lever P, at the extremity of which are two cords, one of which lifts a catch out of a ratchet wheel on the end of the lower beam, and the other slackens the yarn by turning the beam round which it is wound. The other end of the lever P is connected by a cord, with an additional long march hung below for the purpose, and this march being connected with one of the treddles, operates on the lever when required.

Plate CXCIII.

Plate CCXIX. Fig. 8.

Figs. 7, 8.

The patent net represented in Figs. 7. and 8. is another extension of the principle of the mail net, and the difference of appearance consists merely in the omission of the crossing in every alternate square. This net, we have mentioned, was invented at Paisley, and is almost the only variety which has originated in Britain. The difference is entirely in the disposition of the leaves of heddles, and in the rotation in which they are elevated and depressed. The gauze and whip parts are interspersed in an order to suit the pattern, and which will be easily imitated by taking the black dots for the whip or net parts which form the diagonals, and the white dots for the gauze parts. As all the parts are not slackened at once, four distinct beams or rollers are used, each being slackened in its turn. Fig. 7. exhibits the crossings of one range, which is repeated over the whole web. By comparing the crossings of the lams in Fig. 7. with the appearance of the cloth, which in Fig. 8. is represented as unwinding from the beam in a finished state, a pretty accurate conception of the effect produced by the mounting may be formed. The diagonal crossing of one square being included between the numerals 1 and 2, and that of a second between 3 and 4. When the cross lams, which are here exhibited in their slack state, are tightened, the warp will be crossed and interwoven with the gauze, represented by the white dots. This, therefore, forms one range of squares or checkers, with a diagonal crossing in the bosom of every alternate square. When one range is completed, the intermediate crossing between 5 and 6 is set in motion in the same way, and a similar crossing being continued along the whole fabric, the checkers are alternately crossed and blank. For this operation, therefore, four treddles are necessary; two being allotted for each set of the crossings, and each pair is put in motion alternately.

Plate CCXIX. Figs. 7, 8.

Cursory and brief as the preceding explanations are, they may enable even those who study mechanics only as a matter of speculative curiosity, to form some notion of the construction of this curious and hitherto almost uninvestigated branch of their application. It is indeed singular to reflect, that while the construction of almost every engine in other professions has been repeatedly treated of in almost numberless books, there hardly exists a vestige of enquiry into the principles of the staple manufacture of the three kingdoms, and by much the most extensively practised mechanical art in every part both of Europe and Asia, where mechanical improvement has made any progress.

We have already adverted to the Russian table rubber, as an extraordinary instance of mechanical ingenuity, being more extensively employed in a rude country, and upon a coarse and cheap material, than in all the variegated patterns which have occupied the looms employed in fabricating the most costly silks of France and Italy in that description of work. The knowledge of it, as has been stated, does not appear to have ever reached this country. The author of this article shall therefore mention the way in which the plan which he has given of it came into his possession. A considerable number of years ago, whilst he was devoting much of his attention to trace the various ramifications of this extensive but neglected art, a friend, who, besides being extensively engaged in the professional business of manufacturing, possessed a great taste and indefatigable curiosity to analyse the scientific principles of the art, put into his hands a manuscript book, which he had been many years in filling with such remarks upon the art, as had either occurred to himself, or been obtained from a great number of experienced weavers with whom he had conversed on

Cross Texture.

the various branches of the art. Among many curious and valuable articles relative to a great variety of fanciful work, he was surprised to find a drawing of an apparatus for weaving the Russian rubber, which he had always understood to be totally unknown in Britain. Upon inquiry, he was informed, that a very ingenious man, who had been employed in various departments of fanciful weaving, had turned his attention to the subject as a matter of curiosity, and after carefully examining many specimens of the cloth, and using every means to analyze the nature of its fabric, had, partly from his own invention, and partly from such imperfect hints as he could obtain, arranged a small apparatus, which, upon trial, produced exactly the desired effect. From this apparatus, the sketch which he had copied into his book was taken. The general principle of this sketch will be found in Plate CCXX. Fig. 3.

Plate CCXX. Fig. 1.

In Fig. 1. will be found a sketch, which may be supposed to represent the front elevation of a loom, exhibiting the reed and lay in front. Through the reed at certain intervals, which are here represented by every third division, pass a number of those twines which we have already distinguished by the term *lams*, (probably derived from *lamina*,) to the end of which is attached a glass bead. These lams are five in number, that being the number of successive crossings in this curious specimen of crossed texture; and as the same thread is to be crossed five successive times in the same direction, before it begins to return, the whole five lams terminate in the same bead. The other extremity of each lam is attached to a horizontal wooden shaft, of which, consequently, these must be five in number, and these are suspended between the reed and heddles, so that each may be raised successively by a treddle below, of which consequently there must also be five. The lams are numbered 1, 2, 3, 4, and 5, and the bead appears at *a*. The successive dots diagonally marked along the reed B B, may be supposed to represent the warp when the loom is at rest, and when it is but little opened. All the other parts of the apparatus may be supposed to resemble that of other looms for plain work, and is therefore omitted. The shafts for the lams appear above at C, and the treddles below at D, the intermediate marches being, like the other parts, omitted, and the connections supposed to be made directly from the lam shafts to the spring staves E, and from thence to the treddles. The profile is represented by Fig. 2. to show how the apparatus will then appear; and here the shafts for the five lams at C appear very distinctly, the whole terminating below in one bead, and numbered, as the lams were in the former Figure, from 1 to 5. The heddles appear here at F, and the beams of which, to allow for the crossing there, must be 2 at G and H.

Fig. 2.

Fig. 3.

But in order to represent each successive stage of the operation of the lams, a general plan is given in Fig. 3. where may be seen at one view the whole, from one extremity of the crossing to the other, and for this purpose the Figure is divided by vertical lines into six compartments. The letters AB may be supposed to represent the lay and reed with its divisions; CC denote the place where the lam shafts are hung when not elevated, and DD the shafts in a state of elevation. As the peculiarity of this species of weaving consists in one thread undergoing five successive crossings in the same direction, the six divisions of the figure exhibit it in each of the six changes which it undergoes, and then it may be supposed to return to the point from whence it set out in an inverted succession. Besides this, as the weaving of the cloth is progressively advancing during the whole of the operation, the form upon the cloth, if the changes (as is usually the case) be at regular intervals, will be that of a diamond; and if irregularly disposed, almost every variety of figure, depending upon the resolution of two forces at right angles to each other into oblique ones, may be produced. The shaft CC, in its lowest state, may be supposed the first, or that which is distinguished by the numeral 1 in Fig. 2. excepting in the second compartment, when it is elevated, and consequently that which is behind it, or No. 2. appears in front. In the elevated state at DD, every shaft is supposed to be cut away, so that each appears in its turn, and is distinguished by the reference below. The twines or lams are also successively distinguished by numerals from 1 to 5, and the effect of each, by a short explanation, will be easily discernible.

Plate CCXX. Fig. 3.

1st Compartment. All the shafts are here represented as sunk, and consequently all the lams are slack. The thread upon which the whole operate is that nearest to the left side of the Figure, and is now in its natural and parallel state in the warp.

1st Crossing. The shaft 1 being now drawn up, and the lam attached to it tightened, (the thread which it conducts being also proportionally slackened), the lam is pulled under four threads, and then rises in a new place. If the warp is now opened by the treddles, and a thread of woof inserted, that thread passing under the crossed one, will retain it in its new place, but in its natural exertion to return to its former state, the warp which opposes it will be forced together, and a small circular aperture formed bisected as by a diameter line by the thread of woof.

3d Crossing. The first shaft being now sunk again to its former place, and the second shaft raised, the second crossing takes place, four threads being again crossed further to the left. The crossed thread having now deviated still further from its parallel state, the beam upon which it is wound must be proportionally slackened, to give scope for its divergence from the straight line.

3d, 4th, and 5th Crossing. In all these no difference arises, excepting in lowering the shaft, which has already performed its office, and raising that which is next to be brought into action, and thus the operation proceeds until the fifth crossing has been completed; when, according to this plan, the crossed thread has attained its utmost range, although, were the expence of the apparatus not to preclude it, a continuation upon the same principle might continue the same succession in a diagonal line from one side of a web to the other.

To reverse the order of the crossing, it is only necessary to repeat what has been done in an inverted order, when the thread, by the tension of the beam, will revert to its parallel state, as the lams are successively slackened to relieve it.

Whether this be exactly the apparatus used in Russia, we have no means of determining with any degree of precision. The texture of cloth seems in no country to have excited the attention of the philosophical mechanic. In our own, although acknowledged as the staple of the country, and as a most important branch of both its foreign and internal traffic; although deemed of such national importance as to give name to the second chair of dignity in the kingdom, (the woolsack), it is only regarded by men of science as an object of very inferior importance, by statesmen as an article of revenue, and by merchants as a finished branch of commerce. From what has been said of this particular variety, it must be apparent, that it affords scope for a very great extension of the variety of our ornamental manufacture. The principal objection to its adoption seems to rest upon the great extent of the crossing to which the warp is subjected. In the coarse linen fabric to which it is applied, no great difficulty of this kind is likely to occur; for the hemp being a very strong body, capable of bearing much twine, and long in the staple, the coarse yarn spun from it possesses much tenacity. The silk also is very strong, and net work of this kind might be advantageously woven with it. The cotton also, if very well spun, from the finest wool, it is probable might answer very well. The five successive crossings would unquestionably give this net the advantage of great variety over any with which we are acquainted, being in the proportion of 25 changes to four, and hence it seems to open a field for very great improvement in this branch of texture. At present, it is considered as a kind of *Pons Asinorum*, which none of them have ventured to attempt.

Plate CCXX. Figs. 4, 5, 6, 7.

The two Figures 4. and 5. with the small supplementary sketches 6. and 7. relate to a manufacture which may perhaps be considered as not strictly to belong to this article. It is in so far a species of crossed texture, that the figures are formed by crossing a part of the warp, while the rest remains parallel. Goods woven in this way are called lappets; and as it is now unquestionably the cheapest, and consequently one of the most extensive branches of the fanciful manufacture, some account of its principles may, without impropriety, be inserted as the conclusion of this article. Lappets, from whatever quarter the knowledge of them was derived, formed originally in Britain a part of the fanciful manufacture known by the name of silk gauze, the principal seat of which was the town of Paisley. With other branches of that art, they were totally abandoned for some years, and, with very great improvements in the construction of the looms, were again revived in the cotton manufacture. The original plan of weaving lappets was, in some respects, very similar to the apparatus which has just been described, the pattern being formed by bead lams passing through the reed exactly similar to those which it is proposed to employ for the Russian texture. The lappet consists of two warps of different degrees of fineness, one of which forms the ground work or body of the fabric, and the other, which receives the usual appellation of *whip*, is reserved for the ornamental part. The whip, which is much coarser than the body of the web, crosses over the surface of the cloth without being at all interwoven with the warp. If we suppose that three splits of the reed, or six threads of warp, are to be crossed, the whip is then pulled up into the body of the warp by the tension of the lam, and one thread of woof being inserted, secures it there, when it returns to its former place, by slackening that lam and tightening one which pulls in the contrary direction. Thus the whip is alternately pulled from side to side by the alternate operation of the lams; and, like the apparatus of the Russion texture, a number of lams at different intervals are attached to one bead, a zig-zag or diagonal pattern may be formed as the operation proceeds. Again, if the shiftings are not made at regular intervals, but varied, the diagonal line will be often changed, and curves produced, which bear in appearance some analogy either to circular or elliptical figures.

The operation by beads and lams was that by which this manufacture was entirely effected, whilst it was confined to the silk gauzes. But upon its revival in the cotton trade, an improvement, probably the invention of some ingenious, although obscure, operative weaver, whose name has not reached us, entirely superseded the use of the lams, and substituted in its place the ingenious, though simple, apparatus, which will be found by referring to Fig. 4. In this Figure, as usual, the loom is exhibited as an elevation taken in front. The posts are distinguished by AA, the lay and reed by B, and the remaining letters denote the additional apparatus. In the front of the lay, immediately before the reed, and betwixt it and the board upon which the shuttle runs across, is a horizontal flat piece of wood, or what is commonly termed a shaft, which appears at C, placed with its edge up, and suspended by two small cords from the end of a projecting lever, attached to the upper end of each of the swords of the lay, the projection being at right angles behind the lay. The form of these projecting pieces will be more apparent at Z, in the small supplementary Figure 7, where one of them is shown in profile. When the lay is moved back, the end of the projecting lever of course rises, and, by means of the small cord, elevates the shaft C; and when the lay returns to strike home the woof, the shaft again sinks to its former level. In order that the operation of the cord may be in a perpendicular direction, as nearly as the oscillatory motion of the lay will admit, the cords are directed through the eyes of two small staples driven into the lay, and which appear at EE. In the shaft C, at such intervals as the particular disposition of the intended pattern may require, are driven a number of needles made from stout brass wire, flattened a little at one end, and pointed very sharp, that they may rise easily between the warp, without injuring or breaking any of the threads of which it is composed. Near the point of each, a small eyelet hole is also drilled and smoothly countersunk upon each side, to admit and guide the whip thread. From the shaft C is a connection with a small pin at B, by which the shaft and needles may be shifted from side to side in a horizontal direction; and this operation is performed by the thumb of the weaver's left hand, which also works the lay. The shift is performed either to the right or the left when the lay is brought forward, and the needles sunk totally clear of the warp. The distance of each shift is regulated by a small brass rack fixed to the handle B; and the distance of each shift is ascertained by the pressure of a slight spring F, which stops the rack at each notch or division. The alternate rising and sinking of the needles thus produce exactly the same effect that the beads and lams did by the former plan, and the construction is incomparably more simple and easily wrought.

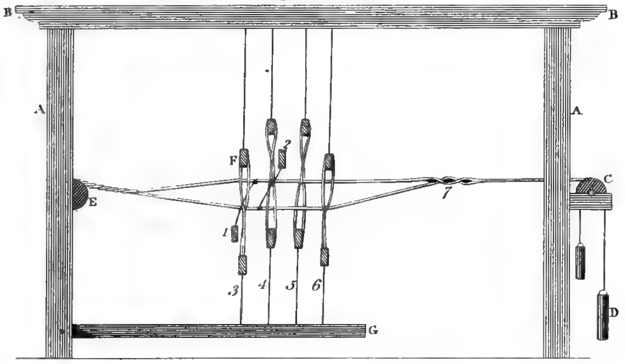
Plate CCXX. Fig 4.

The principle is, however, not only improved, but greatly extended, so as to render it capable of imitating almost every variety of flowers which can be effected by needle-work. The general principle of this improvement and mode of its application, may be pretty accurately understood by referring to Fig. 5. which is also a front elevation of a loom fitted for lappet weaving. The parts of this figure are in general similar to those of the former; but the reed, which should be placed exactly the same way, is omitted to show more clearly the connection subsisting between the handle at B, and the needle shaft at C, by which the shifting motion is com-

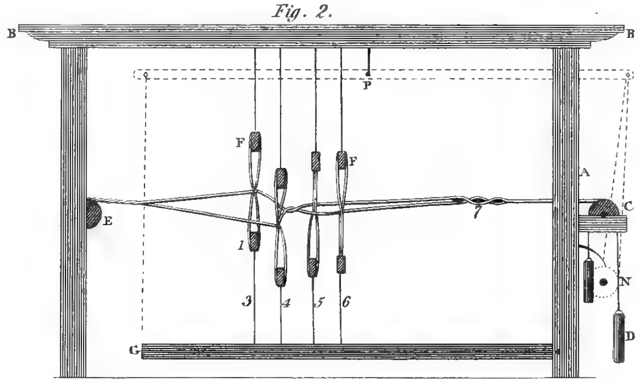
Fig. 5.

CROSS TEXTURE. PLATE CCXIX.

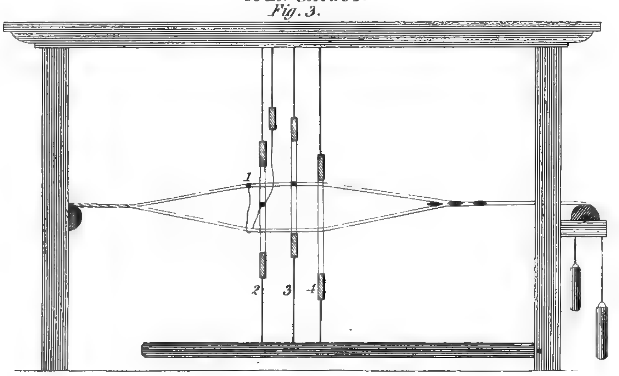
OPEN LINAU.
Fig. 1.



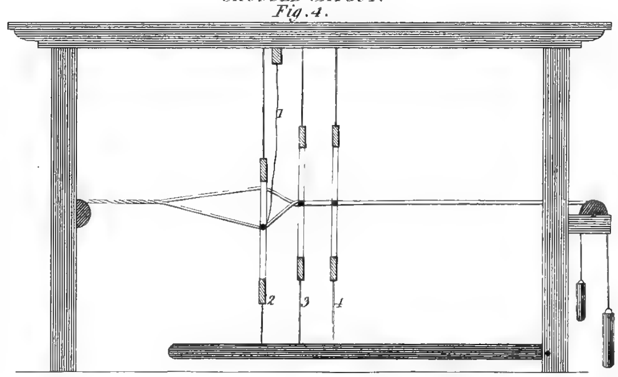
CROSSED LINAU.
Fig. 2.



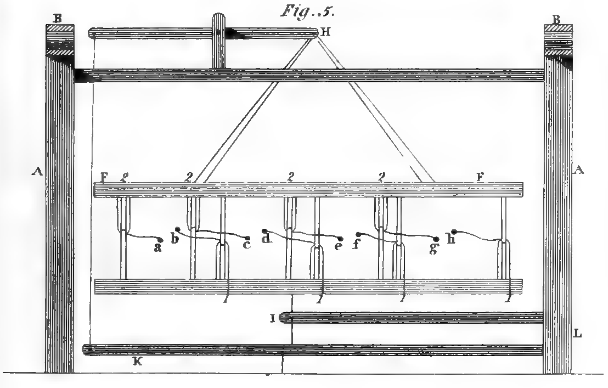
OPEN CATGUT.
Fig. 3.



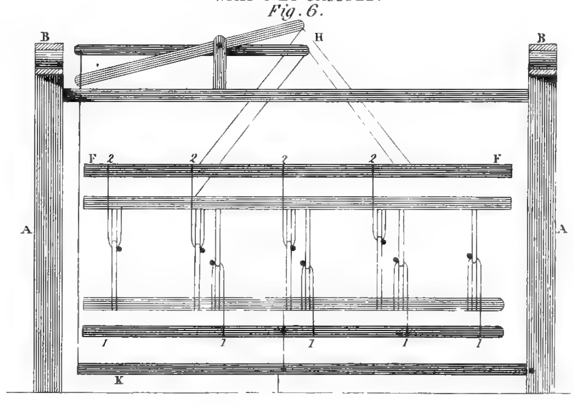
CROSSED CATGUT.
Fig. 4.



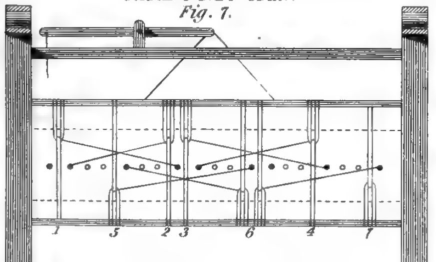
WHIP NET OPEN.
Fig. 5.



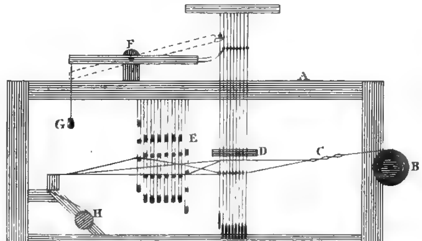
WHIP NET CROSSED.
Fig. 6.



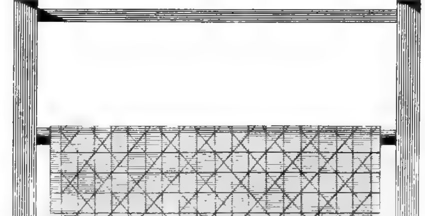
PATENT NET OPEN.
Fig. 7.



PATENT DRAW LOOM.
Fig. 9.



PATENT NET CROSSED & FINISHED.
Fig. 8.



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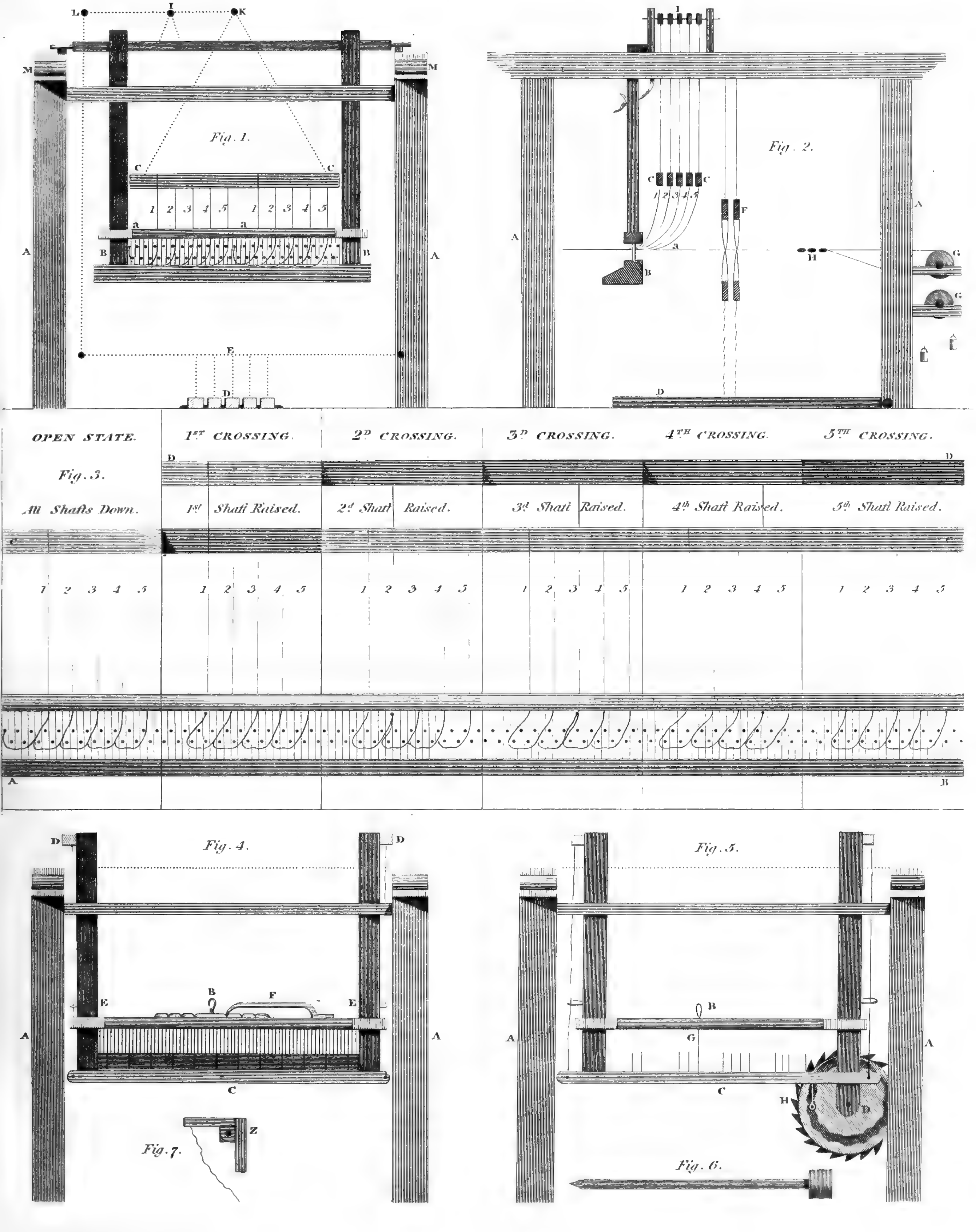
Engd. by J. Moffat Edinr.

CROSS TEXTURE.

PLATE CCXX.



Drawn by John Duncan for the Edinr. Encyclopædia.

Engd. by J. Moffat Edinr.

municated to the latter. This connection is made merely by a strong wire passing through an eye in the shaft, so as to effect the horizontal without impeding the vertical motion, and is distinguished by G. Instead of the rack, the *quantum* of motion is now regulated by grooves cut in the edge of a wooden wheel, which revolves upon its own axis, and may be attached to any convenient part of the sword of the lay. That which is here represented, is placed below merely for the sake of conveniency, as many weavers use them above the level of the cloth and warp. The wheel is represented at the letter D, and as much of it appears as can be visible, the remainder being concealed by the intervention of the other apparatus and the posts of the loom. A piece of wood or metal H, being screwed to the needle-shaft, a small cross pin in its lower extremity enters into a groove cut in the flat side of the wheel D; and the pressure of this pin upon the wheel at either side of the groove, regulates the extent of the shift at either extremity. The revolution of the wheel is effected by a small catch pulling the rachet on the circumference of the wheel D, by means of a cord attached to the extremity of the same lever, which elevates the needle shaft. The groove in D being cut suitably for the pattern intended, a fresh part is presented to the pin H, when every successive shift takes place, and thus any pattern may be formed. The groove is cut from the common design paper described in the general article Cloth Manufacture; and the whole art of marking it out consisting merely in transferring the straight lines of which the design paper consists, so as to suit the circular form of the wheel, the following brief directions may perhaps be deemed sufficient for that purpose if carefully studied.

Plate CCXX. Fig. 5.

If the pattern be drawn upon design paper to cover six threads, these six threads may be represented by three divisions of the design paper, or any number may be taken at pleasure, according to the range of the pattern. To transfer the pattern, the wheel must be marked by the following rules:

1st, Divide the circumference of the wheel into as many equal parts as crossings of the whip are required to complete the figure or figures intended by one revolution. Draw radii from the centre to the circumference, and cut the rachet into as many teeth as there are radii. This part of the operation is to be executed, by counting the spaces on the design from top to bottom, and ascertains the number of crossings in the whole design.

2d, Describe a series of concentric circles, equal to the number of spaces included by the pattern from right to left upon the design, and the divisions will be completed.

Now, as the radii diverging from the centre represent the number of shifts, it is only necessary to ascertain the breadth of each; and these may be found by counting the number of spaces on the design, and marking off the same number of concentric circles on the wheel, and joining the marks by oblique lines, and the limits of the groove will be marked, to which must be added, a space equal to the diameter of the pin which is to work in the groove. The groove being then cut between the marks to a convenient depth, the wheel will be complete, and may contain any number of flowers, either similar, or dissimilar that the projector pleases.

When the pattern is so disposed, it is proper to have an easy and expeditious way of disengaging the needle shaft from the lay, so that it may remain at rest while the interval is wrought plain. This is effected in various ways; and as it differs in no respect from the many well known plans for engaging and disengaging machinery of many different kinds, it is unnecessary to go into detail about it in this place.

The last extension of this species of weaving consists in using a number of different frames at the same time; and as this is only a very obvious extension of the same principle, a few cursory remarks may be sufficient.

The common double frame lappet is wrought with two shafts or frames, by means of a rack, as already described. This apparatus merely doubles and inverts the pattern, and all the additional apparatus consists merely of another frame of needles parallel to the first. From the extremity of the first frame, which is acted upon by the rack, a small cord is taken over a pulley, and tied to the second. A small weight hung from the other extremity of the second frame, by a cord passing over a pulley, preserves the tension of the connecting cord, and, by its own gravity, moves the frame in an inverted direction to the former. By the wheel, a boundless variety might be produced; for were a number of wheels placed upon the same axis, to operate at the same time upon distinct and independent frames, not even the complicated machinery of the draw-loom could be rendered productive of greater effect. Upon the whole, the application of the traverse wheel to the art of weaving, though still very imperfectly understood by the operative weavers, who alone employ their talents for the improvement of the manufacture, is the engine to which the intelligent mechanic may rationally look, both for the extension, improvement, and simplification of his machinery in every branch of the art. (J. D.)

CROSSOSTYLIS, a genus of plants of the class Monodelphia, and order Polyandria. See Botany, p. 268.

CROTALARIA, a genus of plants of the class Diadelphia, and order Decandria. See Botany, p. 276.

CROTCHEY, or Corachie, a sea-port town of Persia, in the province of Scind. It is situated 17 miles east by south of Cape Monze, at the head of a bay, which affords good shelter for shipping, and about a mile from the side of a small creek, which can admit only boats. This town is known by several little islands to the northward, and by a white pagoda, built upon a promontory, which bounds the west side of the harbour, and resembles an island when seen from a distance. Vessels enter the bay between the promontory and the largest island. In order to anchor in the outside road, and to avoid the foul ground, the pagoda must be brought to bear N. W. by N. From this anchorage the town is six miles distant. The harbour is defended on the western point of its entrance by a castle, built in 1801, on which are mounted a few pieces of unserviceable cannon. The streets of the town are narrow and filthy, and the houses, which are built of mud and straw, with flat roofs of the same materials, are fitted only to afford shelter from the sun.

Owing to the nature of the soil, which is sandy and stony, there are almost no vegetables for 40 miles round. The soil may be cultivated during the rains. A few date trees, which never bring their fruit to perfection, grow in the immediate neighbourhood of the town; and lemons, mangoes, grapes, plantains, as well as water, and musk melons, are produced; but the only vegetables are a small quantity of carrots, radishes, pumpkins, and brinjal. The water is brackish. Fuel and forage are scarce. The necessaries of life are however cheap; poultry, black cattle, sheep, and goats being very reasonable; and the country abounds with wild geese, ducks, teal, partridges, snipes, hares, and deer. The country is entirely destitute of timber, and what is needed for building boats and houses is brought from Malabar and Bombay.

Crotchey formerly belonged to the Bloaches; but it was given in exchange for some other place to the Prince of Scindy, who found it a convenient part for the caravans from the inland countries. As the branches of the Indus are too wide and deep for the camels to pass, the caravans are no longer able to come from the interior to Tatta; and on this account the trade of Crotchey is greatly increased.

The imports to Crotchey from Surat, Bombay, Muscat, and the Malabar coast, are,

Betel nut,	Nutmegs,
Cardamums,	Pepper,
Cochineal,	Piece goods,
Cloves,	Rice,
Cloths,	Sandal wood,
China ware,	Japan wood,
Cassia lignea,	Saffron,
Copper,	Steel,
Elephant's teeth,	Sugar,
Iron bars,	Timber,
Iron goods,	Tin,
Lead,	Tutenague,
Looking-glasses,	Vermilion.

By means of the caravans from Cabal and Candahar, they bring to Crotchey,

Almonds,	Grain,
Cinnamon seeds,	Hides,
Dates,	Oil, and
Ghee,	Piece goods.

The exports from Crotchey, which are conveyed in the fair season in dingees, (small coasting vessels, with one mast and a high stern,) to Bombay, Guzerat, and the coast of Malabar, consist of the preceding articles and cotton. Since the trade of Laribunder has declined, in consequence of the shoals, by which the navigation of the river is obstructed, the revenue arising from the customs amounts to 125,000 rupees annually. The population of Crotchey is about 9,000, the majority of whom are Hindoo merchants and mechanics. Crotchey is 57 miles from Tatta, and is situated in East Long. 67° 16′, and North Lat. 24° 51′ 15″. See Milburn's *Oriental Commerce*, vol. i. p. 145, 146; and Macdonald Kinneir's *Geographical Memoir of the Persian Empire*, p. 232. (π)

CROTON, a genus of plants of the class Monœcia, and order Monadelphia. See Botany, p. 329.

CROTONOPSIS, a genus of plants of the class Monœcia, and order Pentandria. See Botany, p. 324.

CROUP. See Medicine.

CROWEA, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 221.

CRUCIANELLA, a genus of plants of the class Tetrandria, and order Monogynia. See Botany, p. 123.

CRUCIBLE. See Chemistry, vol. vi. p. 160.

CRUCIFIXION, a mode of inflicting capital punishment, by affixing criminals to a wooden cross. This was a frequent punishment among the ancients, and practised by most of the nations whose history has reached our knowledge: It is now chiefly confined to the Mahometans.

There were different kinds of crosses, though it cannot be affirmed which was in general use; such as that most familiar to us, consisting of two beams at right angles, and St Andrew's cross. Thus Seneca remarks, '*Video istic cruces non unius quidem generis sed aliter ab aliis fabricatas.*' St Jerome and Isodorus allude to both of the preceding, and Augustine describes the cross on which Jesus Christ suffered as the common cross, but it does not appear on what authority, and a he lived in the fourth century, his information must have been derived from others. Some succeeding authors have also supposed that his feet were fixed to a projection, or bracket below, so that he was crucified in a standing posture, to which the same remark applies. Deviations from the ordinary form and proportions were adopted on particular occasions: accordingly Suetonius relates, that while Galba governed a province, he condemned a guardian to crucifixion, who had poisoned his ward in hopes of succeeding to his fortune. But the delinquent claiming exemption from this punishment, as not appropriated for a Roman citizen, Galba, that it might be less degrading, ordered a cross much larger than usual, and also whitened over, to be made for him, *quasi solatio et honore aliquo pœnam levaturus.* It is necessary to observe, that the numerous and diversified crosses and crucifixes exhibited in sculpture and painting are entirely fictitious. These were gradually introduced as the cross itself became an object of superstitious veneration, and when the devout conceived that their salvation was promoted by constantly introducing some allusion to it. Thus it became an universal emblem of piety among them; and crossing the legs of an effigy on a tomb-stone denoted that a Christian was interred below.

On condemnation, the criminal, by aggravated barbarity, was scourged before suffering death; and perhaps this part of his punishment was scarcely inferior to the other. The scourge was formed of cords armed with bits of lead or bone; or it consisted of simple rods of iron and wood, which latter were called scorpions, when covered with spines. While he suffered, he was bound to a column; and that where Christ underwent scourging, was still extant during the days of St Jerome in the fifth century. This being the common custom, and preceding not only crucifixion, but other kinds of capital punishment, it is an error to suppose that Pilate scourged Christ from motives of greater severity towards him. Indeed, it is rather to be inferred from the whole text of Scripture, that he yielded to popular clamour in consigning him to the Jews. Scourging seems to have been the prelude of death. Thus Quintus Curtius relates, that a band of Sogdians long resisted the progress of Alexander the Great, by taking possession of a cave situated high in a lofty mountain of Asia; but that prince resolving to conquer them, selected 300 men from his army, who had been accustomed to a pastoral life, in rocky and precipitous countries, and whom he induced, by the promise of ample rewards, to ascend the mountain. This they at length accomplished with the loss of many of their number, and speedily finding a way behind the cave, appeared on a pinnacle above it. The Sogdian general, dreading the consequences of their success, ineffectually endeavoured to obtain terms of capitulation, but being compelled to surrender at discretion, he descended from his stronghold, accompanied by his relatives and principal officers. Alexander, by this means, having got them into his power, instead of respecting their bravery as it merited, inhumanly ordered them to be scourged and crucified around the foot of the rock, *quos omnes verberibus affectos sub ipsis radicibus petræ crucibus jussit affigi.* The

Jews captured by Titus at the siege of Jerusalem, were scourged and tortured previous to crucifixion. Anthony scourged Antigonus king of Judæa, which Dio the historian affirms, had never before been done by the Romans to a sovereign, and then beheaded him. That aggravation of severity in the execution of a capital sentence, universal in ancient times, and still practised by barbarians, is justly reprobated by the modern criminal code of civilized nations.

The criminal was compelled to carry his own cross to the place of execution, which was generally at some distance from the habitations of men. This is still the custom in several countries with respect to their capital punishments; and it is probable that inflicting these within the walls of cities was less frequent of old than it is now. A certain gate had its specific name from being the exit of criminals on the way to punishment. It was not the whole cross, according to some, which was borne by the offender, but only the transverse beam, or patibulum, because they suppose the upright part to have remained stationary in the ground, whereas the other was moveable. One of the Roman classics says, *Patibulum ferant per urbem et cruci affigantur*. However, circumstances shew that this could not have been the uniform custom. The criminal, if tardy, was urged along by an iron goad, or stripes; and it is likely that in Rome, either the cross was hung with bells, or that the executioner, ringing a hand bell, preceded it. Formerly it was thought ominous to meet a criminal about to suffer; and a Roman priest or magistrate was polluted by the sight of a dead body, insomuch that certain ceremonies of purification were required before either was entitled to discharge his respective functions. Bells were therefore rung as a warning for all those to remove who might be exposed to contamination; and in the triumph of a victorious general, we are told, that the captives were carried along *dependentibus aliquot tintinnabulis quorum sonitu obvii moverentur, ut devoti et jam funesti corporis contactu abstinerent.*

The criminal having reached the fatal spot, was stripped nearly naked, and affixed to the cross by an iron spike, driven through each hand and each foot, or through the wrists and ankles. Authors are, nevertheless, greatly divided concerning the number and position of the nails in ancient punishments; and it has been conjectured, that in the most simple crucifixion, whereby both hands were nailed above the criminal, and both feet below, all on one perpendicular post or tree, only two were used. The sounder opinion, and that which coincides with modern practice, bestows a nail on each member; and although the following passage is employed in a ludicrous sense, it sufficiently indicates the truth.

> *Ego dabo ei talentum, primus qui in crucem excurrerit*
> *Sed ea lege, ut affigantur bis pedes bis brachia.*
>
> PLAUTUS *Mostellaria.*

That the weight of the body might be the better supported, the arms and legs were encircled by cords, an instance of which occurs in a crucifixion at Algiers, which is thus described by a spectator. "The criminal was nailed to a ladder by iron spikes through his wrists and ankles, in a posture resembling St Andrew's cross, and as if apprehensive that the spikes would not hold from failure of his flesh, the executioners had bound his wrists and ancles with small cords to the ladder. Two days I saw him alive in this torture, and how much longer he lived, I cannot tell."

If the cross consisted of two pieces, it is not unlikely that the hands of the criminal were nailed to the moveable part, or *patibulum*, and that being then elevated along with it by the strength of men, his feet were fixed to the bracket. These facts are extremely obscure, and there is reason to believe, that crucifixion also took place otherwise. From the narrative of a martyrdom, it is evident that the whole cross was on the ground: "He stripped himself of his own accord; then gazing upwards, and rendering thanks to heaven, he extended himself on the cross, so that he might be nailed to it by the executioner; and when fixed, the cross was erected." In like manner, Josephus observes, that "Bassus ordered the cross to be taken down, as he was about to command that Eleazer should immediately be raised on it." And the same is to be inferred from the words of Julius Firmius, an author of the fourth century.

If, instead of being nailed to the cross, the criminal was bound to it by cords, it was designed as a more cruel punishment. Thus in the crucifixion of St Andrew, the proconsul directed the executioner to bind his hands and feet, and suspend him thus, without being fixed by nails, that he might endure the greater torment. Ausonius, in a fabulous narrative, figures a punishment of this description.

> *Eligitur mœsto myrtus notissima luco*
> *Invidiosa Deum pœnis. Cruciaverit illic*
> *Spreta olim, memorem Veneris, Proserpina Adonim,*
> *Hujus in excelso suspensum Stipite Amorem,*
> *Devinctum post terga manus, substrictaque plantis*
> *Vincula mœrentem, nullo moderamine pœnæ*
> *Affigunt.*

The criminal being fixed on the cross, was left to expire in anguish, and his body remained a prey to the birds of the air. His death, however, was not immediate, nor should it be so in general, considering that the vital organs may escape laceration. We learn from the distinct narrative of the evangelists, that conversations could be carried on among those who suffered, or between them and the byestanders: and Justin the historian relates, that Bomilcar, a Carthaginian leader, having been crucified, on an accusation of treason against the state, he bore the cruelty of his countrymen with distinguished fortitude, harangued them from the cross as from a tribunal, and reproached them with their ingratitude, before he expired. There are repeated instances of persons crucified having perished more from hunger than from the severity of the punishment. The Algerine before spoken of, survived at least two days, St Andrew lived two or three, and the martyrs Timotheus and Maura did not die during nine days.

By the Mahometan laws, certain delinquents are to be punished with crucifixion, and killed on the cross by thrusting a spear through their bodies; and here we find an example of what is narrated in scripture, of a soldier piercing the side of Jesus Christ with a lance though he was dead. Among the Jews, we may conclude, from the treatment of the two thieves crucified along with Christ, that it was customary to break the legs of criminals, but whether as a *coup de grace*, like the former, and resembling some modern European punishments, is not evident. It is denied by Lipsius to have been part of the punishment of crucifixion, or attached to it in particular; yet there are passages in Seneca and Pliny which we might rather infer that the reverse was the case, at least with the Romans. Certainly it cannot be considered an effectual means of hastening death. We know, however, that there was a peculiar punishment of this description, and perhaps a capital one, called *crurifrangium* by the ancients, inflicted on Roman slaves and Christian martyrs, as also on women or girls. Augustus ordered the legs of one to be broken who had given up a letter for a bribe; and Ammianus says, " both the Apollinares, father and son, were killed, according to the sentence, by breaking their legs." Under the reign of Dioclesian, twenty-three Christians suffered martyrdom in the same manner. The legs of the criminal were laid on an anvil, and by main force fractured with a heavy hammer, somewhat similar to the modern barbarous custom of breaking the bones of offenders on the wheel by an iron bar. From the narrative of the evangelists, we may conclude, that breaking the legs of the thieves was to promote their death, that they might be taken down the same day from the cross.

That spectators might learn the cause of punishment, a label, or inscription, indicating the crime, frequently surmounted the head of the criminal. The offence charged against Jesus Christ, was having called himself King of the Jews. Accordingly, the inscription on his cross was, " This is Jesus, king of the Jews." By our own customs, a label is sometimes hung from the neck of an offender condemned to lesser punishments, describing his guilt, which is meant to aggravate the ignominy. But among the Romans, this was perhaps also the warrant for putting the sentence in execution. Caligula, at a public feast, ordered the hands of a slave, who had stolen a piece of plate, to be cut off, and hung from his neck, and he was then led round the guests, preceded by a label declaring the cause of punishment. Domitian ordered a person to be taken from the theatre and thrown to the dogs, with a label bearing, " For impious expressions."

That the object of crucifixion might be fulfilled in exposing the body of the criminal to decay, sentinels were commonly posted beside the cross, to prevent it from being taken down and buried. Privation of sepulture was dreaded as the greatest evil by the ancients, who believed that the soul could never rest or enjoy felicity, so long as their mortal remains continued on the earth. Thus, it was a great aggravation of the punishment,

> ———*Scio crucem futuram mihi sepulchrum*
> *Ibi mei majores sunt siti; pater, avos, proavos, abavos.*
> PLAUTUS, Miles Gloriosus.

Perhaps the practice of the Romans was uniform in accomplishing what is expressed in these lines, and, in Petronius Arbiter, it is said of the sentinel, " *Proxima ergo nocte, cum milés qui cruces asservabat, ne quis ad sepulturam corpora detraheret, notasset sibi, et lumen inter monumenta clarius fulgens.*" Whence it appears, that the soldier watched to prevent the removal of the body, which the relatives of the deceased anxiously desired, and, as the same author intimates, succeeded in obtaining. The Jews solicited Pilate to permit the body of Christ to be taken down, because the day subsequent to his crucifixion was a festival; and although the Jewish law in one place says of a criminal, " his body shall not remain all night upon the tree, but thou shalt in any wise bury him that day," it is certain, that on occasions of hostility an enemy was exposed. Seven descendants of Saul having been put to death by the Gibeonites, " Rizpah, the daughter of Aiah, took sackcloth, and spread it for her on the rock, from the beginning of harvest until water dropped upon them out of heaven, and suffered neither the birds of the air to rest on them by day, nor the beasts of the field by night." In proceedings of so arbitrary a nature, and the adoption of customs by nations remote from each other, or living in distant æras, uniformity cannot be thought to prevail. The Mahometan commentators on their own laws are divided concerning the disposal of crucified malefactors; some maintain, that the body should be taken down in three days, others that it should remain on the cross until it decays by the gradual progress of dissolution.

Besides these, the ordinary modes of inflicting the punishment of crucifixion, assuredly sufficiently cruel in themselves, mankind have sought the gratification of vengeance in deviating from them. Such was the conduct of the Roman soldiers under Titus at the siege of Jerusalem, where the miserable Jews were crucified in various postures by their sanguinary enemies. Seneca speaks of crucifixion with the head downwards; and of this we have a noted example in the history of St Peter, during the first century of the Christian æra. Having been seized by the Roman government, and condemned to die on the cross, it is said that he solicited, as a greater degradation, that he might be crucified with his head downwards. Hence Chrysostom exclaims, " Rejoice, O Peter, that you enjoyed the privilege of dying by the cross, and that you desired crucifixion in imitation of your blessed Master, not like him, however, in an upright posture, but with your head downwards, and your feet aloft, as if you had been preparing to journey to heaven." Peter was not a solitary instance; for another martyr, Calliopius, suffered in the same manner: and Eusebius describes the punishment of certain martyrs in Egypt, to have been inverted crucifixion, as an aggravation of punishment.

It appears that delinquents were sometimes affixed to the cross, and burnt or suffocated to death. A Roman emperor commanded that an offender should be treated thus, and suffocated with the smoke of green wood, a crier proclaiming, "Let him who has sold smoke, suffer by smoke." When the executioners prepared to fix Polycarpus to the cross, he requested them to desist, " as without being secured by nails, he who had permitted his death by fire, would endow him with strength to bear it," therefore they only bound him.

With respect to the persons on whom this punishment was inflicted, we have seen that the Carthaginian leaders were not exempt from it; but elswhere, especially among the Jews and Romans, only the lowest malefactors were condemned to the cross. It was peculiarly appropriated for slaves.

> *Pone crucem servo: meruit quo crimine servus*
> *Supplicium?* JUV. *Sat.* v.

The author of the Bellum Hispaniense annexed to Cæsar's Commentaries, says, *Ea nocte speculatores prehensi servi tres et unus ex legione vernacula. Servi in crucem sublati; militi cervices abscissæ*, cap. 20. Crucifixion is always called *servile supplicium* by the Latin writers. Livy also, in speaking of a revolt among the slaves, which Marcus Acilius the prætor marched with an armed force to quell, observes, that many were killed in an encounter, some captured and restored to their owners, but the ringleaders were scourged and crucified; and Augustus crucified thousands at a time in Sicily, who wanted masters. Soldiers, and especially deserters, were subjected to this punishment. It was not, however, the proper punishment of the former, whence Vulcatius apparently reprehends Avidius Cassius, because he ordered soldiers, who had forcibly despoiled the inhabitants of a province of their property, to be crucified on the spot, of delinquency; and it is elsewhere said, "for he crucified soldiers, and subjected them to servile punishments." Fugitives are said, by Valerius Maximus, to be most deserving of crucifixion, *cruce dignissimi fugitivi*, which Livy illustrates in the punishment of deserters thus: *de perfugio gravius quam de fugitivis consultum: Nominis Latini qui erant securi percussi. Romani in crucem sublati.* Thieves and robbers in particular were condemned to crucifixion, of which we have an example in the two thieves mentioned by the evangelists: and Valerius Maximus, in a chapter on *Severity*, relates, that a wild boar of extraordinary size being brought to Lucius Domitius the Roman governor of Sicily, he ordered a shepherd who had killed the animal, to appear before him. An edict having lately been promulgated, that no one should be in possession of a weapon, because the province had been pillaged by robbers, he asked how the shepherd had killed the boar; and on his answering that it was with a boar-spear, ordered him to immediate crucifixion. By the Mussulman laws, a magistrate may condemn certain highway robbers, either to the cross or to lose their hands. But for one robbery, both punishments cannot be inflicted, because by the code of the Mahometans, no single offence can receive a double punishment.

In the destruction of an enemy, in religious persecutions, or popular commotions, it is likely that neither age, sex, nor condition, was respected: and we read of women being condemned to the cross. Eurydice, queen of Ptolemy Philopater having been put to death, and the king passing his time in weakness and debauchery inconsistent with the benefit of the state, a tumult was excited, wherein the courtezans who lived with him were crucified to avenge the fate of his queen: Tiberius also, on a certain occasion of adultery in the temple of Isis, ordered a female called Ida, to be crucified as well as the priests of the temple; and female martyrs suffered in this manner during the persecutions for Christianity. The fortitude of Simeon, a Christian ecclesiastic who was crucified, at the venerable age of one hundred and twenty, has been handed down to the admiration of posterity. But the cross has been made a more terrible instrument of destruction to a vanquished enemy. Thus Alexander the Great, we have already observed, crucified the Sogdian officers and their leader, at the foot of their strong hold; and at a another time, after putting eight or ten thousand Tyrians to the sword on taking their city, he crucified 2000 more along the shores. *Triste deinde spectaculum victoribus ira præbuit regis. Duo millia in quibus occidendis defecerat rabies crucibus affixi per ingens litoris spatium perpenderunt.* Not less sanguinary was the vengeance of the Romans against the Jews; Minutus Alexander crucified 800, and Quinctilius Varus 2000, on account of some revolt. Titus, whom we are wont to esteem as humane and merciful, crucified above 500 in a day; and at the sack of Jerusalem, under his command, the Romans, wherever they could seize the affrighted fugitives, either in hatred or derision, nailed them to crosses about the walls of the city, until the multitude was so great, that room was wanting for the crosses, and crosses for the bodies.

Crucifixion has been considered the most cruel of punishments, and merited by the most atrocious offences only; but the barbarity of mankind has made little distinction in making punishments commensurate with crimes; and condemnation to torture has been dealt with a lavish hand. That the pain of the cross is cruel cannot be denied, yet we are perhaps accustomed to exaggerate it from our unacquaintance with other punishments. Examples are not wanting of persons having been taken down from the cross alive, and surviving the laceration of their members. Josephus the historian relates, that on leaving a particular town in Judea, he saw a great many of the enemy crucified; but it grieved him much to recognize three of the number with whom he had been in intimate habits. He hastened to inform Titus of the fact, who immediately ordered them to be taken down, and their wounds carefully healed. Two nevertheless perished: but the third survived. See *Seneca de Consolatione, ad Marciam*, § 20. Petronius Arbiter *Satyricon*, cap. 3. *Valerius Maximus*, lib. vi. cap. ii. *externorum*. § 1. cap. iii. § 5. *Suetonius in Vita Galbæ*, cap. 9.—*in Vita Domitiani*, cap. 10.—*Augusti*, cap. 68. Justin *Historia*, lib. xxii. cap. 7. lib. xxx. cap. 1, 2. Livius *Historia*, lib. xxx. cap. 43.—lib. xxxiii. cap. 36. *Quintus Curtius*, lib. iv. cap. 4.—lib. vii. cap. 11. Eusebius *Historia Ecclesiastica*, lib. xi. Josephus *De excidio Judæorum*, lib. v. cap. 12. Zonaras *Annales*, lib. ii. Vulcatius *in Vita Avidi Cassia*. Gallonius *de cruciatibus Martyrum*. (*c*)

CRUDIA, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 214.

CRUSADES.

CRUSADES, military expeditions, undertaken by the Christians of Europe, for the deliverance of Judæa from the dominion of the Turks and Saracens. These expeditions, like some which are recorded in the history of the heroic ages of antiquity, shew the power of superstition to inflame the passions, and call forth the energies of the human mind. The mere prosecution of a foolish object may often be productive of greater benefit, than the actual accomplishment of one more judicious. If eagerly pursued, it augments activity by exercise. Even though unattainable, it puts ingenuity to the stretch, and acquaints us with our possession of powers, which may afterwards be better directed; and as chemistry was promoted by a search after the philosopher's stone, the revival of civilisation was accelerated in Europe by a childish contest for a barren mountain in Asia. We shall treat the subject, therefore, as deriving more importance from its moral consequences, than from its historical facts, which differ little from those of other religious wars; and having given a rapid outline of the latter, we shall consider the former at greater length.

About 70 years after the death of Christ, the city of Jerusalem was taken and destroyed by Titus. In the year 130, it was rebuilt by the Emperor Adrian, and the Christians were permitted to return to it. Their establishment, however, was by no means flourishing, till Constantine embraced their faith, when his Empress Helena visited Jerusalem, and having ordered all the places which had been signalized by evangelical events to be cleared of rubbish, inclosed those of the most hallowed sanctity, within the walls of a spacious church. In the latter days of the empire, the decay of reason, which had kept pace with the decline of knowledge, made way for that superstition, which transfers its feelings to the material objects with which they are associated, and a strong desire was consequently felt by the ignorant and zealous Christians, to visit the scenes which were so often in their thoughts. What was at first the indulgence of a sentiment, appeared at last the execution of a duty; and pilgrimages to Palestine became a frequent, because an applauded practice through the whole of Christendom. In 637, Jerusalem was conquered by the Saracens, whom interest induced to continue to the pilgrims a peaceable reception; but this ceased to be the case, when the Turks, in 1065, got possession of the holy city. That wild and ferocious tribe, though superior in force, were inferior in civility to the Saracens of Arabia, and made so little scruple to plunder and insult their Christian visitors, that the dangers of pilgrimage, painted in the most terrific colours, by those who returned from them, began to threaten a discontinuance of this sacred duty. In Europe, at that period, the minds of men were in a state most favourable to be powerfully agitated by tales of outrage, heightened by the impiety of its perpetrators. They were in that stage of intellectual childhood, when passion, prevailing over reason, receives with eagerness every thing that is strange or dreadful, and under the force of its impressions, favours the introduction of the most extravagant opinions. Ignorance was so universal, that the slender knowledge possessed by the clergy enabled them to command a veneration, and acquire an influence, which they did not fail in converting to their own advantage. For this they had a tempting opportunity, the system of civil government being then as imperfect as that of spiritual tyranny was complete. Under the feudal system, every Baron was a petty prince, who acknowledged but a slight allegiance to the sovereign; and, like the members of the German empire, in our own day, granted or withheld his military services, at his own pleasure. In addition, therefore, to the wars of nations, the wars of districts were incessant; and the general character, being a compound of turbulence, animosity, and ignorance, was a desireable subject for the successful application of superstitious terrors, by which it could be persuaded into any sacrifice however great, or roused to any enterprise however perilous. At this period, the papal authority was in its plenitude; and kings, like their subjects, were enslaved to the superior craft of the priesthood. The Roman empire of the East still protracted its feeble existence at Constantinople; but all its Asiatic provinces had fallen under the dominion of the Saracen Caliph, or rather of the Turkish Sultan, who exercised the sovereignty in the character of his delegate.

In this state of things, an ecclesiastic of Amiens, who was afterwards celebrated by the name of Peter the Hermit, returned from Palestine, after suffering exactions and injuries, which he described, at Rome, with such inflammatory pathos, as to awaken the pity, or rather the ambition, of the sovereign Pontiff. Urban II. like his predecessors in the chair, had long cherished a design of repelling the encroachments of Mohammedism, by the arms of Christendom, and thought the eloquence of Peter might be employed as an instrument to gain the co-operation of the European princes. He sent him, therefore, into the different states of Italy and France, where, in sermons, he told his piteous tale with such effect, as drew to his harangues auditors of every rank and of incalculable number. After this preparation of public feeling, Urban assembled a general council at Placentia, which was attended by 4000 clergy and 30,000 laymen, and at which the project of invading Palestine was applauded by all; but the frenzy of the Italian barons was not yet wrought up to such a pitch as seduced any one to embark in it. The experiment was, therefore, repeated; and in a council at Clermont, the superior ardour and impetuosity of the French were shewn by their promptness, not merely to applaud, but to enlist in an expedition, which would both give them an opportunity of signalizing their prowess, and indulging their taste for adventure, and would likewise purchase for the young nobility a papal pardon of the numerous sins with which they were burthened by habitual dissipation. On this occasion, the Pope himself was the preacher, and spoke with such animating effect, that his harangue was interrupted by unanimous shouts from the multitude of "God wills it—God wills it!" His holiness then intimated, that the cross should be the badge of the combatants. This figure was accordingly worn upon their shoulders, and the expedition was named a *croisade*. A crowd of all descriptions enrolled themselves under the banner of Peter the Hermit, who placed himself at the head of 80,000 recruits, with sandals on his feet, and a rope round his middle. The 15th of August, 1096, was fixed for beginning their march, but to the impatient spirit of the zealot army, the day appeared too distant; and 60,000 of them set out from the borders of France and Germany, early in spring, under the guidance of Peter, whom they had compelled to this precipitation of the measure. These were followed by another band of 15 or 20 thousand; and in the rear of all, came a mob of 200,000, who exhibited in their conduct the most singular extremes of fanaticism and vice. The Jews of Germany were their first victims; but their outrages in Hungary and Bulgaria drew upon them a severe retaliation from the inhabitants, and not more than a third part of this undisciplined multitude escaped, with Peter, to Constantinople, where their succour against the Turks was eagerly expected by the Emperor. Tired, however, with their depredations, he persuaded them to proceed into Asia, where they were met by Sultan Solyman, and almost totally destroyed on the plain of Nice; Peter himself and a slender remnant of his frantic host being all that returned to the Byzantine capital.

But though this premature and infatuated swarm of crusaders was thus swept away, the most valuable part of the expedition was still in reserve. Godfrey of Bouillon, Hugh of Vermandois, Raymond of Tholouse, Bohemond and Tancred, with many more of the minor European princes, had, by the sale of their domains, assembled regular and well-appointed armies, which, after the pope had declined an invitation to head them, marched at the appointed time towards Constantinople. These new guests, though somewhat less uncivilized than their brutal precursors, were still extremely troublesome to the Greek emperor. By flattery and address, however, he prevailed on them to pass the Bosphorus; and when reviewed in the neighbourhood of Nice, they amounted to 100,000 horse, and 600,000 foot, among whom the women and followers were included. Provisions for this crowd were supplied by the maritime towns of Italy; and Genoa was indebted for its subsequent importance, to the wealth acquired

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in a traffic, which the necessities of the crusaders could not fail to render lucrative. Having taken Nice, and defeated Solyman, in 1097, they proceeded eastward, where Baldwin conquered Edessa, and erected it into a separate principality for himself. In the end of 1098, they took the town, but not the citadel of Antioch; and an army of 600,000 Saracens, which had moved to the relief of the latter, was totally defeated and dispersed by the besiegers. In 1099, the crusaders, with little more than a twentieth part of their original number, advanced to Jerusalem, which, after a siege of forty days, was taken by storm, and all its inhabitants, except the Christians, sacrificed in a general massacre. At this scene of barbarity, Peter was present, in the character of a chaplain, for which he had judiciously exchanged that of a general; but his patron Urban died before the gratifying intelligence could reach him. The heroic Godfrey was raised by the army to the throne of Jerusalem; and in the first, and only year of his reign, he added double security to his conquest, by defeating the Egyptian sultan, with an innumerable army, at Ascalon. He was, notwithstanding, defrauded of the reward of his valour, by a papal legate, whom the clergy elected to the patriarchate of his new kingdom, and who contrived to include the temporal in the spiritual power, leaving to Godfrey only the little principality of Jaffa, and a few immunities in that of Jerusalem. The crusaders, after seeing their object accomplished, began to return to Europe; and the few who remained in the Christian settlements of Jerusalem, Antioch, and Edessa, to which a fourth was added, by erecting the Syrian Tripoli into a domain for the young count of Tholouse, were obliged to depend for defence against the Turks, on the gradual accession of adventurers, whom the fame of their previous exploits allured from Christendom. An army of these recruits, amounting to 200,000, was collected by Hugh, brother of Philip I. king of France; but they never reached their destination, being cut off in hostilities, first with the Greeks, or afterwards with Solyman, who still occupied the open country of Asia Minor.

The Christians, at length, finding themselves surrounded with foes, (for even the emperor, though their liege-lord, viewed them with the same hostility which he had felt for their Moslem predecessors,) supplicated a second crusade, which was preached, in 1146, by Bernard, the sainted founder of the monastic order of Bernardines. His eloquence having persuaded Louis VII. of France, and Conrad III. of Germany, with 300,000 of their subjects, to assume the cross, Conrad took the lead, but was defeated by the Turks near Iconium, and with difficulty escaped to Antioch. Louis, a short time after, suffered a similar fate; and both returned home, after witnessing the ruin of the finest armies which their countries had ever produced. The disastrous issue of these attempts for their relief, only hastened the decline of the Christian principalities in Asia. Adversity created divisions among them, which might have been still more fatal, had not equal discord prevailed among their enemies, which gave the former an opportunity of forming an alliance (1166) with the Saracens of Egypt against the Turks of Syria. This, however, was of short duration; and had it been more permanent, could not have availed to resist the illustrious Saladin, who, about the middle of the 12th century, raised himself, from a humble attendant of the caliphs, to the sovereignty of Persia, Arabia, Syria, and Egypt. The next object of his ambition was the contiguous kingdom of Jerusalem; and in the battle of Tiberias, having defeated its army, and taken Guy of Lusignan, who then wore the crown, he made himself master of the city in 1187. Saladin, however, whose valour was equalled by his generosity and wisdom, though he restored Mohammedism, tolerated Christianity in his new conquest; but a few cities on the coast was all of which the Christians retained an independent possession in the East.

Though, in a rational age, the capture of Jerusalem should not have affected the happiness of Europe; yet as ideal evils are frequently the greatest, it was felt through Christendom as an intolerable calamity, and the Pope (Clement IV.) took advantage of this sensation, to unite its sovereigns in a new crusade. The great thrones of the West were, at this time, occupied by princes of eminent talents, who employed them as the fashion of the age prescribed. Philip the Second of France, Richard the First of England, and the German Emperor Frederick Barbarossa, engaged with much zeal in the expedition; but the last of these princes having defeated the Greeks, who had preferred an alliance with Saladin to one with the crusaders, and having, afterwards, been twice successful against the sultan of Iconium, was drowned accidentally in crossing a river. The French and English kings were more fortunate, and arrived at Ptolemais while besieged by the Asiatic Christians, with a force which, when united with the besiegers, made an army of 300,000 men. Ptolemais was taken, but Philip, disgusted with the real or affected superiority of his rival, returned home; and Richard had the glory of defeating Saladin, undiminished by the claims of a partner. The army, however, being reduced, not more by the usual waste of war, than by those intestine quarrels which are fatal to almost every military coalition, he, like the preceding leaders, returned, unaccompanied even by its remains, to Europe. Judging of others by his own generous nature, he took his way through Austria, though he had quarrelled with its prince in the East, and being arrested, was kept in prison till an immense ransom had been procured from his subjects. Before his departure from Syria, he had made a peace with Saladin, who soon after died.

Notwithstanding the misery which had been the uniform result of the crusades, such was the prevalence of fashion, or the ascendancy of the priesthood, that fresh adventurers were ever ready to renew them. In 1202, Baldwin, Count of Flanders, collected an army to act against the Mohammedans, but began, as usual, with the Christians of Greece. Arriving at Constantinople during a disputed succession, his interference tempted one claimant to assassinate his rival, and Baldwin, after dispatching the survivor by a public execution, and indulging his followers with the plunder of the city, sat down on the imperial throne of the Eastern empire. In this splendid acquisition, it is not surprising that the original object of the crusade was forgotten, and that the adventurers preferred the destruction of their fellow Christians, and the spoils of an empire, to a doubtful contest with the Saracens, and the recovery of a sepulchre. Only a few knights crossed to Asia, and the fourth expedition terminated without a single conquest from those against whom it had been equipped.

The frenzy of Europe, however, continued unabated; and John de Brienne, a young French gentleman, being appointed King of Jerusalem, and taking the aid of the Duke of Austria and the King of Hungary, made a descent on Egypt with 100,000 men, from a hope that, by destroying the power of its sultan (brother to Saladin) at the seat of government, the distant dependency of Jerusalem would fall of course. He was at first successful, and after a long siege took Damietta. But a papal legate insisted on superseding him in the command; and during the delays created by this dispute, his army was surrounded by the inundation of the Nile, and he was forced to purchase a retreat by the cession of his conquests, and the surrender of his person as a hostage. Another of the western emperors now became the leader, and renewed the hopes of the crusaders; but this prince, who engaged in the enterprise entirely from policy, avoided the hazards of war, and got possession of Jerusalem by a treaty with the sultan. It did not, however, remain long in possession of the Christians, for Judea (1244) was overrun by the barbarous Tartars, who fled before the irruption of Jengis, and its maritime towns were all that the crusaders retained.

From this uniform round of enterprise and disaster, which renders the narrative of one crusade almost a transcript from that of another, the zeal for renewing them had begun to languish, when a monarch appeared on the throne of France, in whom the superstition of the age was superadded to every amiable and heroic virtue. This was Louis IX. who, after contenting himself for some time with the proper duties of his office, and labouring for the external security and internal improvement of his kingdom, was at length persuaded that he had been warned by heaven, in a dream, to assume the cross. Resisting, therefore, the entreaties of his family and ministers, and embarking with an immense force in the ports of the Mediterranean, he first touched at Cyprus, and afterwards landed in Egypt. The sultan proposed a treaty, which Louis rejected; and after losing one half of his army by sickness, attacked the Saracens with the remainder, but was defeated and taken, near Massoura, in 1250. During his captivity he was treated with the most generous respect; and having ransomed himself and his followers, he removed from Egypt to Palestine, where he remained for some years, and then returned to his own dominions with the sanguine hope of equipping a new expedition. After his arrival, he again devoted himself to the duties of government, and, by the institution of courts of justice, the encouragement of letters, and a general attention to the happiness and improvement of his subjects, performed a service, and earned a glory, far superior to those which he had relinquished, but which he still unfortunately preferred. His piety was ardent and sincere; but being misled by directors who were either deceitful, or themselves deceived by the prevailing absurdities of opinion, he never ceased to pant after a new crusade.

At length, unable to resist his impatience, he once more sacrificed a real to an imaginary duty, and (1270) embarked with an armament from the south ports of the kingdom. His brother, at that time king of Sicily, whose crafty ambition was equal to the unsuspecting sincerity of Louis, seized the opportunity of turning the spiritual zeal of the crusaders to his own temporal advantage. He pretended to have some pecuniary claims against the king of Tunis, whose dominions he had a secret wish to acquire, and by persuading Louis that he had a fair chance of converting, or compelling that prince to the profession of Christianity, the pious warrior was seduced to make the attempt. Having accordingly landed his army, it encamped near the ruins of Carthage, but was immediately surrounded and besieged by the Moors. A contagious distemper attacked his troops: he caught it himself, and died in the 55th year of his age. This prince was among the last, and was certainly the most to be regretted, of all the victims to crusading fanaticism. Had he lived in a more enlightened age, his personal virtues would have been a blessing to the world, whose misery was augmented by their misdirection. After his death, his brother made peace with the Tunisians, and the skeleton of his army returned to France. Long before the age of St Louis, the appetite for holy wars had declined throughout Europe, and the small number of recruits, who arrived in Palestine, had induced the Christian settlers to intermarry with their Moslem neighbours. The descendants of the crusaders had consequently degenerated into a mixed race, and had almost forgot their slight pretensions to an European origin. They retained only Tyre, and Acre or Ptolemais; the latter of which being taken by Melecseraph, Sultan of Egypt, in 1291, the former also surrendered. Their surviving inhabitants were blended with the Mohammedan population of Syria, and not a vestige of the Christian conquest remained.

Such is a hasty sketch of these famous expeditions, which, although to us rendered more interesting by our descent from their authors, exhibit all the disgusting features of the other religious wars, which deform the history of mankind, and depress our triumph in the excellence of human reason. In each, we find the same ignorance in the popular mind; the same direction of it to a trifling object; the same exaggeration of some imaginary evil; the same devotion of every comfort for its redress; and the same domination of a crafty priesthood, seeking to augment its consequence and authority, by engaging the people in measures of which it was the sole projector and guide. In the crusades, therefore, the historian sees little that is new, and while relating them, only traces afresh a part of the circle which human folly is destined to describe; but to the philosopher, who follows out their consequences, no subject can be richer in materials for speculation. The evils which they created were immediate and obvious; the advantages were more remote, and require demonstration to claim our assent. The crusades caused a waste of life and labour beyond example, without the temptation of any prospective return: they, for two centuries, afflicted almost every family in Europe with the most painful privations; and they alienated the attention of its inhabitants from the improvement or enjoyment of their natural blessings. Agriculture and commerce, arts and education, were neglected by every rank, under a general distemper of the imagination, which represented happiness to consist in the possession of a distant land: and to the attainment of this object, which was to give their value to all the rest, they sacrificed the flower of successive generations, and the strength and ornament of their respective countries. Yet with all these pernicious effects, the philosopher will find in the crusades, if not the origin, at least the chief auxiliary cause of a total change in the aspect of society; for though the tide of civilization, in which a return from its lowest depression was scarcely perceptible, might of itself have continued to rise, its motion would have been slow and feeble, but for an impulse undesignedly communicated by these extraordinary expeditions. We shall therefore subjoin a few remarks on the measure in which they affected, 1st, the political condition; 2d, the manners and customs; 3d, the literature and the arts; and 4th, the religion of Europe.

Effects of the crusades on the political condition of Europe.

1. The period at which the crusades began, was that at which the irruptions of the northern and eastern barbarians closed. These had confirmed their settlement in the countries which they overran, and had effaced every vestige of the Roman policy, by the introduction of their own. The latter, as might be expected, was rude and irregular, and from its military origin, terminated in what is too well known to require description by the name of the *Feudal System*. Under this system, the nobility enjoyed a subordinate sovereignty, in their own domains; and though acknowledging a species of allegiance to the king, as the original granter of their lands, yet the acknowledgment was understood to imply so imperfect an obedience, that its occasional violation was accounted neither criminal nor infamous. A kingdom resembled a cluster of confederated states, under a common head, like those of Greece in the days of Homer, with this difference, that, in the former case, the crown was hereditary, which rendered its power proportionally greater. When obedience was refused, it could be enforced only by war, and not by law; and thus a great baron was more like the royal rival than the subject of his nominal superior. He had his own courts of justice, his own mint, and his own army. He made war upon his neighbours; and the pillage of their domains was regarded as the spoils of conquest, not of robbery. Every kingdom was, therefore, a scene of turbulence and distraction; and the tenants of adjoining baronies felt the same mutual hostility, as the subjects of conterminous states at present. The king naturally strove to augment his authority, but he could do so only by dividing the nobility, and then securing the alliance of the most powerful, or by extending his own domains, in the way of purchase or forfeiture. Kings, therefore, encouraged the crusades, from secular, as well as from spiritual motives. The barons who engaged in them, acting not more from superstition, than from a desire of military glory, were generally the most warlike of this intractable order, and their absence was on that account desirable. Sums were required to convey their troops to foreign service, for which their annual revenues were insufficient; and as the expedient of loans was not yet devised, they were obliged to alienate their lands for such a price as they could obtain. Of this necessity their sovereigns took advantage, and by thus enlarging their personal possessions, enlarged their political power. When the kings themselves were infected by the crusading *mania*, they raised money from the sale of municipal privileges to the towns; and this, though an apparent abridgment, was a real extension of their authority. As the consequence of the people advanced, that of the nobility, which was injurious to order, and which opposed the chief resistance to royal authority, declined in proportion; and when this unintended effect was perceived, kings became more willing to emancipate the lower orders of their subjects from feudal servitude. In this manner corporations were formed, with a species of republican jurisdiction, within their own limits and ideas of liberty, which had long been dormant, began once more to revive. These made the most rapid progress, and reached the greatest perfection, in the maritime cities of Italy, which, from the wealth acquired, by supplying the means of transport and subsistence to the crusaders, were enabled to erect themselves into independent commonwealths. From the co-operation of all these circumstances, the power of government and the efficiency of law were increased; the protection thus afforded to property gave new confidence and a new motive to industry; and men being called into situations which obliged them to think and act for themselves, their faculties were quickened by exercise, and directed to objects of enquiry which had formerly been unknown. If, for example, we turn to England, in the reign of Edward the First, who had himself engaged in the last crusade, we find the power of the monarchy wielded with unprecedented ease and energy; we find the people embarking in commerce and navigation; we find the laws improved, and their administration invigorated; we find the rudiments of our present constitution distinctly visible; and we find the youth, instead of limiting their attention to bodily exercises, frequenting the universities, and cultivating their understandings. In France, at the same period, the advance was still more considerable; and though in both countries, partly owing to the personal character of the sovereigns, it must be also ascribed in part to the causes which have been already assigned.

Effects of the crusades on the manners and customs of Europe.

2. In the age preceding the crusades, the manners and mode of life which prevailed through Europe, were gross and unpolished. This must naturally be the case, among the members of small societies, who live in habits of ferocious hostility with their neighbours, and of close and rude familiarity with each other. Into such societies every kingdom was divided. The precincts of each estate were a constant scene of that border warfare, which is the most brutalizing of any; and the conviviality of the baronial hall was, as constantly, the reward of the vassals, on their return from pillage. Their lord was obliged, in order to secure their attachment, to indulge them in intemperance, and in those coarse and turbulent pastimes which suited "the unyoked humour of their idleness." Himself and his relations, having few other associates, were frequently induced to mix in their revels, and a tincture of masculine semi-barbarism was thus diffused, even through the higher orders of society. The distinction between the practice of private war and that of indiscriminate robbery was so faint and equivocal, that heroes of the highway were held in little dishonour, and the right of plundering passengers, within a definite district, was sometimes annexed, by grant, to the possession of certain manors. That respect for the fair sex, which is at once a cause, and a consequence of polished manners, could, in these days, have little influence, as women were classed among other articles of property and plunder, and depredations on *moveables* of this description were frequently the origin of the baronial wars. Previous to the crusades, indeed, a partial remedy, or rather a feeble palliative, for the evils created by this dissolution of order, had arisen from the institution of chivalry. Some individuals, whose natural ideas of justice and humanity were superior to those of their age, determined to supply the deficiencies of law, which permitted injuries too painful for their sensibility to witness, and assuming the character of judges, in every case of oppression, enforced their decisions by their own personal prowess. The weaker sex, and those of the other, who, from profession, were most pacific, became the principal objects of their protection; and the pleasing consciousness of performing acts of generosity, and at the same time of indulging the prevailing propensity to acts of valour, rendered the occupation fashionable, and introduced sentiments and manners of a new and interesting kind. These voluntary champions of injured innocence formed themselves into fra-

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ternities, which were governed by their own rules, and into which candidates were admitted with martial and religious ceremonies. In the modern orders of knighthood, these fraternities still preserve a nominal existence; but until chivalry was rendered superfluous by improvements in policy, and ludicrous by the humour of Cervantes, it continued to be a dignified and serviceable institution. For the encouragement and extension of these societies, nothing could be better adapted than the crusades, which were indeed a general enterprise, on the principles of chivalry, undertaken by confederated Christendom. The motive which led to them was indignation at the oppression exercised by the Saracens; and in their progress, many who engaged in them were reduced to such extremities of distress, and dereliction, that various orders of knighthood, especially those of St John and of the Temple, were founded expressly for their relief. The admiration which the crusaders enjoyed, rendered those eastern orders more honourable and permanent than others, and the spirit of chivalry was strengthened at home, by its adoption among the venerated warriors in Palestine. In this spirit were implied a punctilious obedience to the laws of honour, morality, and religion, a dignified courtesy of deportment, and an elaborate tenderness and respect for the fair. In short, *parcere subjectis et debellare superbos* was the general motive by which, on all occasions, it was to be swayed. The new direction which was thus communicated to the activity of human nature, and the ambition of extracting and combining all that is most laudable in the ecclesiastical and military characters, soon produced a visible effect on the aspect of society. Men became more guarded in their mutual intercourse; fashion succeeded, where better principles had failed in improving their conduct; and weakness being invested with an ideal sanctity, which gave it all the advantages of strength, the general comfort was increased by a consciousness of increased security. This direct and imperative operation of chivalry was essentially aided by the change of habits and opinions, which gradually and insensibly proceeds from foreign travel, and from the union of various nations in a common enterprise. Nothing is better fitted to supply the absence of literary education, than visiting new countries, and acting with new associates. It enlarges the views, and corrects false habits of thinking; it teaches us to regard in a proper light, things to which we had attached undue importance; it imposes the necessity of accommodating ourselves to practices and opinions at variance with our own; and it accustoms the temper to forbearance and pliability, and the mind to discretion and address in the ordinary affairs of life. Travelling of any description produces these effects, but travelling as a soldier accelerates them: for as the character is generally barbarised by the petty and acrimonious contests of neighbouring tribes, it is raised and refined, in an equal proportion, by military service on an extended scale, and against a remote and unhabitual opponent. We there contend with men to whom we are individually unknown, and against whom we feel no personal resentment; we learn to measure our hostility, not by passion, but by the necessity of the case; we learn from our own wants, to put the proper value on humanity, to mingle courtesy with valour, and to sympathise in the sufferings of the foe whom we have overcome. With our fellow soldiers, too, our companions in peril and privation, and in all the most interesting situations of life; the sharers in our wistful yearnings after that native land, which is endeared to us by a consciousness of extending its glory, and earning its applause, and to which, amid our toils, we often jointly look forward, sustained by the cheering hope of *fortasse et hæc olim meminisse juvabit*; with these we form a friendship of the most cordial and delicate kind, which exalts, as much as it softens the affections, and which, by giving exercise to the best dispositions of our nature, imparts a manly but captivating amenity to our general deportment.

Such were the effects to be expected from the expeditions to the East, and we accordingly find that, after their operation had time to be felt, the manners of the European nations underwent a perceptible change; while the general imitation of their darling champions introduced the rudiments of modern urbanity, and of those usages which, by implying mutual good will and respect, are found so convenient in smoothing the surface of social intercourse. In the East too, and especially in Constantinople, where the luxury and splendour of an imperial capital had never been interrupted by the establishment of barbarians, the crusaders became acquainted with modes of life which were superior to those of their own countries, and of which, on their return, they were ready to report the advantages, and urge the adoption. This produced, in the 12th and 13th centuries, a rapid improvement in the dignity of courts, in the refinement of pleasures, and in a general taste for those accommodations, and that order and elegance of domestic arrangements, with which the feudal nobility had never thought of gracing the rough hospitality of their halls. The castle of Windsor, which was built about 40 years after the termination of the crusades, is an existing monument of the sort of lodging which was then required by a monarch.

Effects of the crusades on literature and the arts.

3. At the time when the crusades began, Europe was involved in the grossest ignorance. All that remained of ancient science and art was confined to Constantinople, and to the more enlightened of the Saracens, who first from the vicinity, and afterwards by the conquest of Alexandria, added to their native literature a considerable knowledge of the Greek philosophy. Though, in visiting these regions, the crusaders were actuated by no desire of mental improvement, and could not boast even that portion of knowledge, which stimulates to the acquisition of more, yet they must, from the very boldness of the enterprise, have carried with them a vigour of mind, which is seldom unaccompanied by curiosity. This curiosity would be sharpened by an endless succession of new objects and singular characters; and it is scarcely possible that some of them should not have perceived the value of that information of which they were destitute. Of the clergy, in particular, who monopolized all the learning of the age, some among the numbers who proceeded to the East, might have been expected to study the language of the Greeks at Constantinople, or the philosophy of the Saracens in Egypt. No instances, however, can be given of the importation into Europe of any interesting addition to literature, by the votaries of the cross, and we must, therefore, content ourselves with the general fact, that the close of these expeditions was the commencement of a new era in the history of human intellect. The 12th century was the period when it seemed to awaken from its torpor, and to resume its activity, which, though long ill directed, was useful in preparing it for more judicious exertions. A distinguished author (Mr Gibbon) has maintained, that the progress of literature in Europe was retarded, not accelerated,

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by the crusades. But this opinion seems objectionable, for the following reasons, drawn from the nature, and confirmed by the history of the mind. Exercise of one kind disposes the mental faculties, not to indolence, but to exercise of another. Even among barbarians, it is the old warrior who becomes the bard or historian of his tribe. It is those who have themselves made extraordinary exertions, who are most anxious to know what exertions have been made by others. It was after the long wars between the Spartan and Athenian states, that the genius of the Greeks broke out with greatest lustre; and we shall find, that all the golden ages of literature, either immediately succeeded, or actually coincided with periods of excessive agitation, from foreign or intestine conflicts. By analogy, therefore, we may infer that the interesting novelty, and extensive commotion of the crusades, were better fitted to excite the faculties, and fire the imagination, both of those who performed, and of those who promoted them, than the petty contests and insipid routine of rustic sports, which alone, but for this diversion, would have interrupted the slothful uniformity of their European homes.

In the intellectual progress of nations, poets and fabulous historians are the first writers who appear; and whatever stimulates the fancy may be considered as favouring the creation, because it accelerates the commencement of an age of literature. In this view the crusades must have been highly beneficial. They familiarised the minds of Europeans with the splendid fictions—the *speciosa miracula rerum*—on which the genius of the East has always delighted to dwell. Nay, the very occurrences of these expeditions, magnified by the vanity of those who had shared in them, were singularly suited to quicken the embryo seeds of poetry in the breasts of their ingenious countrymen. We accordingly find in the earliest writers of Europe, in Dante and Boccaccio, and in our own poets, from Chaucer to Milton, a frequent propensity to avail themselves of Oriental notions, and to give additional attraction to their writings, by allusions to the romantic adventures of the holy warriors, and to the preternatural, but interesting extravagances which were grafted on them. In so far, therefore, as the crusades supplied a spur to curiosity, and materials to those who could increase its impulse by gratification, in the same degree they must have contributed to assist the ordinary march of intellect, and to give it a more vigorous motion at its outset, than it would otherwise have so speedily acquired. Whatever hastens the age of poetry, must hasten that of philosophy, by which it is naturally succeeded. In addition to these speculative grounds of belief, we have direct evidence that the crusades, even by their successless issue, were of advantage to letters. The popes, after perceiving the inefficiency of carnal weapons, to resist the triumphs of Mohammedanism, had recourse to those of a spiritual and logical kind, by which they hoped, instead of conquering, to convert the Saracens. Young men were, therefore, appointed to be educated as future missionaries; and even at the early period of 1285, Pope Honorius had proposed the establishment of a college at Paris, for the purpose of instructing them in the Oriental languages, that, in his own words, "they might fulfil the intentions of his predecessors." Actuated by similar views, the council of Vienna, in 1311, declared that the revival of letters was the true method of converting the infidels, and of securing the recovery of the Holy Land; and we shall find, by inquiry, that it is nearly to the same period, and probably to the same design, the foundation of many foreign and domestic seminaries of learning must be referred.

On the other hand, it cannot be denied, that, if the crusades were ultimately useful, they were, in various respects, immediately detrimental to the advancement of knowledge. During their continuance, military fame was the chief object of ambition to all who aspired at distinction. A cultivated mind conferred no importance in society, compared with talents for war; and after the institution of chivalry, admission into any of its orders was sufficient to give a youth that rank and respect, the hope of which is the principal incentive to literary labour. Even when some would have preferred an attempt to advance themselves by the latter, they were prevented by the heavy contributions imposed for the equipment of crusading armies. These exhausted all their means, and obliged them to forego that education, and the provision of those books and other helps, for which studious men require a certain measure of ease, if not of affluence, in their circumstances. It must also be confessed, as a proof of the incurious ignorance of the age, that no part of Arabic science, of which Europe has availed itself, was imported by the crusaders. The arithmetical cyphers were known in the west, before the 11th century. The translation of Aristotle, whose authority continued to be long so unprofitably idolized, was obtained from the Saracens in Spain; and the astronomy and geography of the Arabs were transmitted to Christendom, through the same channel.

But if Europe was not much indebted to the crusades, for the direct improvement of science, with respect to the advancement of commerce and the arts, the case was very different. Before the 12th century, there had been no regular and systematic communication between the ports of Europe, and those of Asia and Africa. Commerce was so little valued, and so little understood, that France had allowed her maritime cities, on the Mediterranean, to remain in the hands of the counts of Tholouse, the kings of Majorca, and other petty princes; nor had the idea yet occurred to the Italians, of extending their traffic beyond their own vicinity, and of rendering their ports the *entrepots* for Indian commodities. In short, the numerous and signal advantages of water-transport had never drawn the attention of the European nations, till the destructive disasters of the first crusaders, in attempting a march by land, forced upon the mind of their followers the expediency of changing their element. Ships for their conveyance were, therefore, collected to an unusual number in the Mediterranean ports, and these were afterwards employed in carrying provisions to the crowd, which they had previously landed. By the consequent frequency of voyages to Palestine, the arts of navigation and shipbuilding were rapidly improved; and from this period may be dated the maritime eminence of Pisa, Genoa, and Venice. By the example of Italy, the French monarchs perceived the expediency of obtaining possession of the Mediterranean coast; but it was not till the embarkation of St Louis and his armies, which required no less than 1800 transports, that the port of Marseilles began to rise from its preceding obscurity. The impulse having once been given to the spirit of naval adventure, it went on with increasing activity, till it produced the remarkable change on the aspect of human affairs, which succeeded the discovery of America, and of the naval route to India. The profits, too, which arose from the supply of necessaries to armies at the distance of Palestine, called

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the attention of traders to the advantages of an extended transfer of commodities; and the example of the Italian towns was gradually followed by other countries. Wealth was thus introduced into the states of Europe, and the inhabitants prepared, by the enjoyment of affluence and leisure, to relish and require the luxuries of knowledge and the elegant arts, which are never encouraged, till the more urgent cravings of nature have been supplied. In further proof of the benefit which trade derived from the crusades, we may add that the commercial regulations of Richard I. which he promulgated on his return from Palestine, under the title of the "Laws of Oleron," were the wisest then known, and no less remarkable for their justice and humanity than for their prudence.

Effects of the crusades upon religion.

4. To religion, as to letters, the crusades, though immediately injurious, were the remote cause of beneficial changes. At their commencement, the papal authority was in its plenitude, and the sovereign pontiffs, who had subjected Europe, were desirous of reducing Asia under their singular mixture of temporal and spiritual tyranny. But of all such attempts of extravagant ambition, the failure weakens, as the success confirms, the power of the projector. When Europe, disgusted by two centuries of disaster, began to suspect the folly of these expeditions, it must have also begun to doubt the infallible judgment of their ghostly promoters. This doubt, being once introduced into thinking minds, (and such must have been the first to entertain it,) would naturally increase; and when aided by the new vigour which reason had, from other causes, acquired, may be supposed to have operated, as a slow and imperceptible preparative for the doctrines of the reformation, the rudiments of which were suggested by Valdo, about 50 years before, and by Wickliffe, about 50 years after the final recapture of Palestine. During the progress of the crusades, however, that blind and fanatical devotion to the will of the priesthood, without which the people could never have been seduced into so wild an enterprise, seems to have rather increased than declined. Nothing, indeed, was omitted by the popes and their subordinate agents, to carry this principle to its most extravagant height, and thus to accomplish the object on which they had fixed, as necessary to the consummation of their paramount supremacy.

Indulgences, or an exemption from the penalties of purgatory, were granted with a profusion, most subversive of morality, to all who were willing, either by personal service or pecuniary contributions, to forward the conquest of Palestine. The eagerness of the people to drug their consciences, which were purposely agonized, by the venders of the opiate, rendered this artful expedient too productive to be discontinued, after the principal cause of resorting to it had ceased; and the sale of indulgences was afterwards converted into a regular branch of the ecclesiastical revenue. The infamy of such a traffic, in which the interests of virtue were sacrificed by those who exclusively pretended to maintain them, could not fail to be at length perceived, and is well known to have been the chief of those multiplied abuses of human ignorance, which gradually led intelligent men to detect the delusions, and to deny the legitimacy of the Romish church. During the crusades, the interests of the priesthood were artfully identified with those of the Christian faith; and the zealous, but bewildered, laity endeavoured to support the latter, by the most extravagant donations to the former. This liberality was generally directed to the monasteries; for the conventual character had acquired additional value with the people, from what they had seen or heard of the ascetic practices of the East. New monasteries were, therefore, endowed, and new fraternities instituted by the church, that it might provide sufficient channels, through which the bounty of its infatuated votaries should flow. But the popes, not contented with increasing the wealth and numbers of the priesthood, took advantage of the opportunity offered by the crusades to fortify themselves still farther, by instituting orders of knighthood, who, among their other duties, obliged themselves to be champions of the church and of all its rights. But even these auxiliaries, though an apparent addition of strength, in reality increased the weakness, and accelerated the downfall of pontifical domination. The ecclesiastical warriors, who, by a vow of celibacy, exposed themselves to double temptation, and who, under the sanctity of a semi-canonical vocation, could indulge with more freedom the licentiousness of military habits, speedily sunk into the most abominable debauchery. Wealth and indolence, too, produced their usual effects on the monastic orders, who shewed, by their open and unguarded indecencies, that they considered the subjection of the popular mind to be complete and irretrievable, and that the trouble of disguising their vices might therefore be spared. This security created in the popes such a contempt for the public understanding, as led them to insult it with the most absurd additions to the creed. Of this description were the doctrines of transubstantiation, the adoration of the host, the worship of the Virgin, and the efficacy of the rosary, all of which were the inventions of the 13th century. Though, for a time, these ludicrous or idolatrous tenets met with implicit belief, yet human reason, which, by its progressive maturation, was silently resisting every effort to protract its weakness, could not long submit to the wanton mockery which they implied. It was provoked to an investigation and assertion of its natural rights, the result of which, combined with indignation at the dissolute example of the military and monastic orders, contributed to produce that memorable revolt against papal oppression, by which, two centuries after, Christendom was convulsed and purified.

These causes were aided by the persecuting spirit of the church, which, if not created, was confirmed by the crusades. We naturally indulge hatred, from a desire of self justification, against those whom we attack; and hence, during the eastern expeditions, aversion at infidels became the most prevailing sentiment in Europe. This sentiment was propagated by the clergy with so much success, that we find it give a tincture to the style of the times, in which the epithets of *miscreant*, *paynim*, or *recreant*, are the strongest expressions of vituperation and abhorrence which language could supply. When the mind has been enslaved to such a feeling, it is easily transferred from unbelievers to those of our own communion, who differ from us, by the nicest shade of opinion, in religious metaphysics, and experience has abundantly proved, that, in the last case, its asperity is embittered, by the constant irritation which vicinity occasions, and by a closer contact with the objects of detestation. It is, therefore, by no means surprising that the wars with the Saracens, should have introduced an excessive jealousy of heretical notions, and an implacable spirit of persecution at home; or that the cruelties, which were the consequence, should, by natural reaction, have led to that obstinate resist-

Fig. 4.

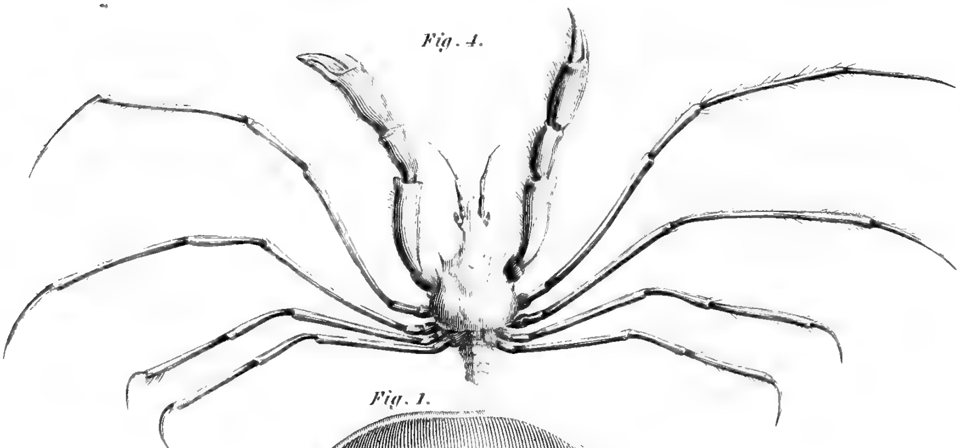


Fig. 10.

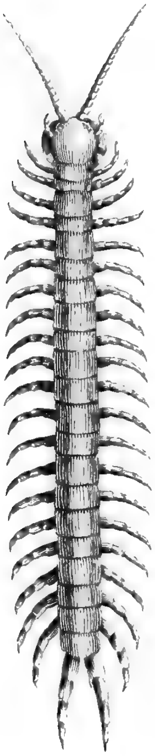


Fig. 1.

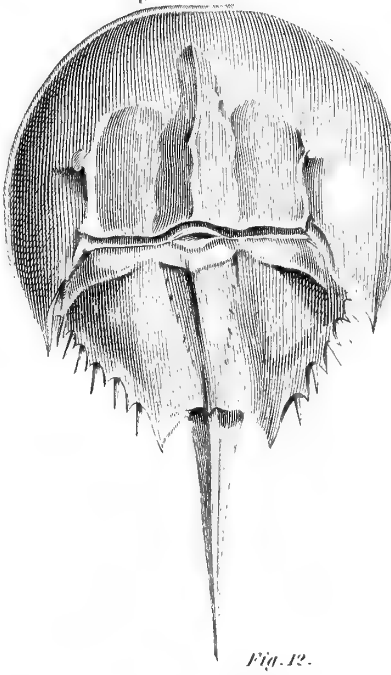
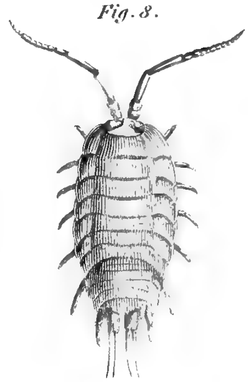


Fig. 7.

Fig. 8.



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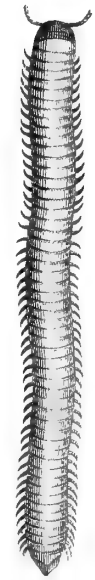

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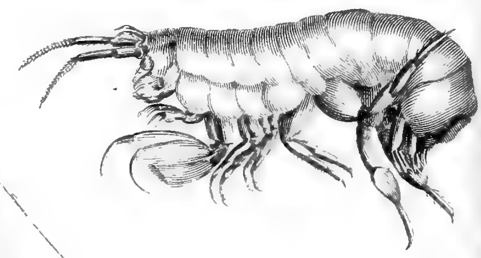


Fig. 12.

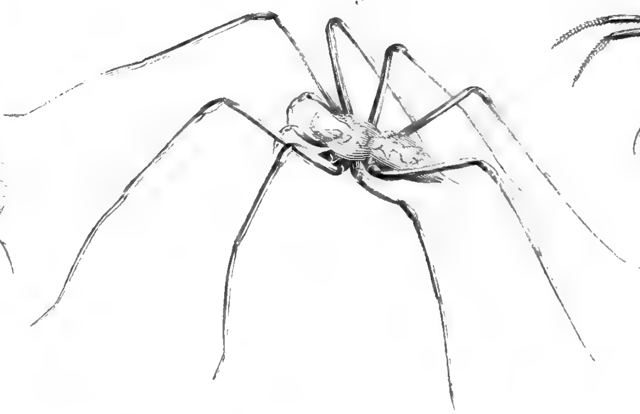


Fig. 2.

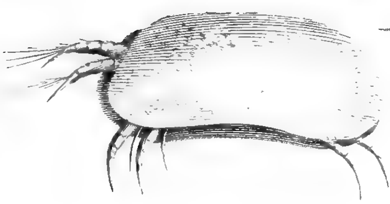


Fig. 3.

Fig. 11.

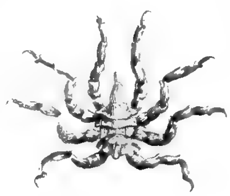
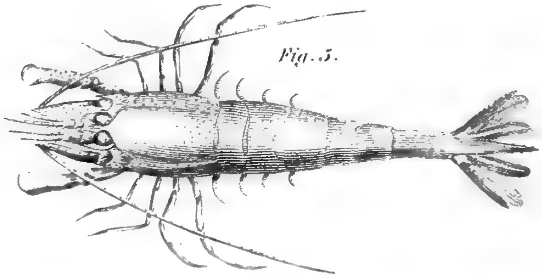


Fig. 5.



Drawn by Dr. Leach for the Edinr. Encyclopaedia.

Engd. by A. Wilson Edinr.

Crusades.

Effects of the crusades upon religion.

ance, on the part of the sufferers, and to that exertion and illumination of mind, which terminated in the Protestant reformation.

We conclude with repeating, that the favourable results which we have attempted to trace to the crusades, even should the fairness of the deduction be admitted, will by no means exculpate their authors from the charge of criminal ambition, or enthusiastic folly. In manners, policy, and commerce, they had neither wisdom to foresee, nor virtue to design any improvement: and if their conduct produced advantages to literature and religion, these being diametrically opposite to their desires, implied as much demerit of intention, as the injudicious violence against a victim under torture, which exasperates a sullen tumour into an open ulcer, and thus accelerates the cure of an evil which it was expected to increase. See Gibbon's *History; Histoire Generale de* Voltaire; *Histoire des Croisades de Mainbourg; Esprit des Croisades.* (J. W.)

CRUSTACEOLOGY.

Crustaceology.

Crustaceology treats of the characters of two classes in Zoology, viz. Crustacea and Arachnides. Formerly, both these were arranged by Linné and his followers under the general denomination Insects, (*Insecta*); but the more extended, and consequently more accurate, observations of modern zoologists, have authorised the separation of the Crustacea and Arachnides from Insecta; a division perfectly warranted, not only by the difference of most important characters, but also the great facilities which it affords the student of nature. In the following pages, we shall first treat of the Crustacea, and then take into consideration the characters of the class Arachnides, which holds an intermediate place in the system of nature between the Crustacea and Insecta, and point out their systematic connection and arrangements.

Class I. CRUSTACEA.

Crustacea.

History.

This name, by which the class is distinguished, derives its origin from *crusta*, a *crust* or *shell*, because the animals have all a covering of that kind. The animals themselves are known under the familiar appellations of *crabs, lobsters, shrimps, prawns, centipedes, millepeds, &c* These were considered by the ancients as a subclass of fishes, connecting true fish with the testaceous vermes (*mollusca*); and this opinion prevailed, with very little variation, as recently as the time of Linné, who, in the great revolution which he effected in every part of natural history, separated the Crustacea from fishes and worms, and placed them with insects. After Linné, our industrious countryman Pennant seems to have been the first to separate the crustacea from insects. He has, however, neglected to assign any reason for this change, which renders it rather an innovation than a reform, and deprives him of any claim of priority which he might otherwise have deserved. He appears to have been rather influenced by caprice, than by any conviction of the correctness of his principles, (as we infer, from his wantonly re-connecting the whales with fishes, and in other instances, in which his chief aim appears to have been, to differ from his immortal predecessor Linné,) and on these grounds we shall not farther insist on his claims.

The illustrious French zoologists Cuvier, Lamarck, Latreille, and Dumeril, separated the *Crustacea* from *Insecta*, abandoning all the former opinions prevalent on the subject. How far they may have been right in thus rejecting the doctrines sanctioned by so many men of eminence, remains to be examined; and we are much disposed to think, that the grounds on which they have acted, will be found sufficiently firm to warrant the steps they have taken. In such enquiries, we are not to be governed by prejudice or veneration for the works of older writers, in those points where our own judgment may be employed with equal or even greater certainty. The *magni nominis umbra* has something so imposing on the minds of those too strongly inclined to worship it, that it cannot be too sedulously guarded against. Much caution is however, necessary, in the examination of innovations, and the utmost impartiality is to be used. It is true, that animals may have a decided resemblance in their external characters, whilst their internal structure is totally different. This has been considered the case with the classes in question, although it appears to us very absurd to have placed together animals so very distinct: How ridiculous must it appear even to the most cursory observer, to be told that crabs and lobsters are insects! yet such was the opinion of Linné, and even at this time (although the continental writers unanimously agree in considering them distinct) many collectors, either from accustomed habit, or veneration for Linné, still consider the crustacea as a branch of Entomology, and as they both agree in having articulated limbs and antennæ, they are admitted by most British collectors into their cabinets as genuine *insects*; their internal structure, economy, and external appearance, being disregarded.

We shall now lay before our readers, the observations of Cuvier, Dumeril, Latreille, and Lamarck, and endeavour to point out the most obvious distinctive characters of the Crustacea. It appears, that they agree with insects, in having in common with them articulated limbs and antennæ, but differ most essentially in anatomical structure. The Crustacea breathe by *gills* like the Mollusca, and have generally four *antennæ* or *horns*, and often six *mandibules* or *jaws*; likewise a *heart* like the Mollusca. They undergo little or no transformation; and lastly, they breed more than once. Insecta, on the contrary, breathe by *tracheæ* or *windpipes*, have never more than two *antennæ*, no *mandibules*, no heart, and they all undergo more or less transformation, and perish as soon as the procreation of their species is effected.

Such are the most remarkable characters of the two classes, which warrant, upon every principle, their separation from each other. Indeed Linné himself, with that clearness and accuracy which distinguished his general views in every department of natural history, has laid the foundations of these recent changes effected by the foreign zoologists. That great man has taught us to consider the internal organization "a natural, certain, and unerring guide in the classification of animals." We feel, therefore, fully convinced, that these changes will meet the views of all those who are competent to appreciate the true principles that should regulate every philosophical arrangement.

In the arrangement of the three classes Crustacea, Arachnides, and Insecta, we have adopted certain alterations suggested by Mr Leach, of which we shall give some account: He has proposed to take from the class Arachnides, the orders, I. Tetracera, II. Myriapoda of Latreille, and add them to the Crustacea; and also to take from the same class, the order Parasita of the same author, and add it to Insecta, which, by this alteration, will include all those animals having two antennæ and six legs: the Arachnides, by the same improvement, will take in all that have no antennæ; and, lastly, the Crustacea will comprehend the remainder. On this mode of arrangement we shall say nothing, except that it seems well adapted to facilitate the progress of the student, and on this ground appears to deserve attention.

The following are the characters of the class Crustacea:

Anatomical Character.

Heart single; branchiæ for respiration; no vertebræ; spinal marrow with many knots or ganglia; muscles for moving the feet.

External Character.

Body with naked jointed feet, formed either for swimming or running; no wings; covering crustaceous, horny, or membranaceous, either shield-shaped, or bivalve. Branchiæ placed under the shell.

This class is divided into three orders. 1. Entomostraca. 2. Malacostraca; and, 3. Myriapoda. The latter was placed in the class Arachnides, by Latreille; but, as already mentioned, we are inclined to place it with the Crustacea, for several reasons which we shall state in their proper place. We now proceed to define the Orders, Tribes, Families, and Genera of the class Crustacea.

ORDER I. ENTOMOSTRACA.

Feet either branchial, or furnished with leaf-like processes. Body, with a coriaceous or membranaceous covering, which is either shield-shaped or bivalve. Eyes, generally sessile or fixed; in some few pedunculated, or placed on a footstalk. Palpi, double. Mandibules, obscure or wanting.

In this order the antennæ are sometimes wanting, in some they are very obscure, in others pencil-shaped, or branched. The *eyes* are generally two in number, in some distinct, in others united, so as to appear as one; the *mouth,* furnished either with jaws or a proboscis. The *mandibules* without palpi. *Maxillæ* or *jaws,* four or six. *Feet,* generally ten in number, formed for swimming. *Tail,* furnished with lamellæ or setæ, and sometimes with a sword-like process.

Observation. Some of the animals of this order undergo changes during their growth; these peculiarities will be noticed when the individual species are described.

TRIBE I. THECATA.

Shell, shield-shaped.

Family I. Xiphosura.

The clypeus or shield double, completely covering the body; the feet simple and unequal in size; tail sword-shaped; antennæ scarcely visible; mouth with mandibules.

Genus I. Limulus. Shell composed of two pieces; mandibules double-jointed; tail horny and sword-shaped.

Family II. Pneumonura.

The clypeus single; feet simple, and unequal in size; mouth with a rostrum; tail fibrous, or leaf-shaped.

Genus II. Caligus. No mandibules; tail with two filaments; the anterior feet terminated by a hook, the rest formed for swimming.

Genus III. Binoculus. No mandibules; tail with two lobes; the anterior pair of feet terminated by a nail, the second pair conic, the rest formed for swimming.

Family III. Phyllopoda.

The clypeus single; all the feet furnished with leaf-like fins; tail fibrous or filamentous.

Genus IV. Apus. Mouth with mandibules; tail with two setæ; the feet leaf-shaped.

TRIBE II. OSTRACODA.

Shell bivalve; Eyes most frequently confluent.

Family IV. Monophthalma.

Eyes confluent, or running together so as to appear but one.

* Two eyes.

Genus V. Lynceus. Head exserted; antennæ capillary.

** One eye.

Genus VI. Daphnia. Head exserted; antennæ branched.

Genus VII. Cypris. Head concealed; antennæ terminated by a brush.

Genus VIII. Cythere. Antennæ hairy; head concealed.

TRIBE III. GYMNOTA.

Shell without any covering.

Family V. Pseudopoda.

Head closely united to the thorax; feet obscure or obsolete.

Genus IX. Cyclops. One sessile eye implanted in the front of the thorax.

Family VI. Cephalota.

Head large, and evidently distinct from the thorax.

* Eyes sessile.

Genus X. Polyphemus. One eye; two branched feet extending horizontally.

Genus XI. Zöe. Two eyes; rostrum longer than the thorax, and perpendicularly placed.

** Eyes pedunculated.

Genus XII. Branchiopoda. Body filiform.

ORDER II. MALACOSTRACA.

Feet either formed for swimming or running, the tarsus being furnished with a horny tail. Body, with a calcareous covering; two moveable and pedunculated eyes, (in the third Family the eyes are fixed.) Antennæ in all the genera four, four double. Palpi attached to the mandibules.

Crustacea.

In this order the covering is always calcareous, and is generally shield-shaped. *Antennæ* always four in number; the interior pair often divided. *Eyes* generally pedunculated, or placed on a footstalk; in some they are immersed in a socket. *Mouth* armed with jaws. The *mandibules* two in number, bearing palpi. *Maxillæ* six in number, placed in a longitudinal line, one above the other. Four double *palpi* situated under the maxillæ. *Feet* ten, in some fourteen, formed for swimming or walking; the tarsus terminated by a horny nail. *Tail* simple, or armed either with lamellæ or styles.

Observation. The animals of this order undergo no transformation; they are for the most part produced from eggs. In the last Family, the females carry about their young, until they are large and strong enough to provide for themselves.

TRIBE I. BRACHYURI.

Tail shorter than the body, having no caudal fin.

Family VII. Cancerides.

Shell transverse, or heart-shaped in some; round or square in others. The longitudinal very rarely exceeding the transverse diameter. Antennæ inserted into excavation on the middle of the clypeus.

I. Anterior part of the shell rounded; posterior margin straight.

* Hinder feet formed for swimming, the last joint being much compressed.

Genus XIII. Podophthalmus. Peduncle of the eyes reaching the external anterior margins of the shell.

Genus XIV. Portunus. Peduncle of the eyes much shorter than the external anterior margins of the shell.

** Hinder feet, as well as all the rest, formed for running, the last joint being conic.

Genus XV. Dromia. Hinder feet placed on the back. Shell very convex.

Genus XVI. Calappa. Posterior angles of the shell arched, so as to receive the hinder feet when contracted. Hands crested.

Genus XVII. Hepatus. The second joint of the peduncle of the external double palpi triangular.

Genus XVIII. Cancer. The second joint of the peduncle of the external double palpi quadrangular.

II. Shell more or less square.

Genus XIX. Ocypode. Eyes with an elongated footstalk inserted into the middle of the anterior margin of the shell.

Genus XX. Grapsus. Eyes with a short peduncle inserted in the anterior angles of the shell. Interior antennæ concealed by the inflexed clypeus.

Genus XXI. Plagusia. Eyes with a short peduncle inserted at the anterior angles of the shell. Interior antennæ inserted into two little foveolæ on the upper part of the clypeus.

Genus XXII. Pinnotheres. Shell roundish-square. The internal footstalk of the exterior double palpi one-jointed.

Family VIII. Oxyrhynchi.

Shell somewhat oval or triangular. The longitudinal exceeding the transverse diameter. The anterior antennæ generally exserted.

I. All the tarsi conic.

Genus XXIII. Leucosia. Eyes and antennæ minute. The footstalks of the external double palpi equal.

Genus XXIV. Maja. Eyes distant from one another, and not small. The joints of the internal footstalk of the external double palpi with two broad joints. Hinder feet not spurious.

Genus XXV. Macropodia. Eyes distant from one another. External double palpi porrected. The second joint of the footstalk elongated. Hinder feet not spurious.

Genus XXVI. Lithodes. Eyes near each other at their base. Hinder feet minute and spurious.

Genus XXVII. Corystes. External antennæ porrected as long as the body. The second joint of the internal peduncle of the external double palpi lengthened, and gradually narrowing towards the apex.

Genus XXVIII. Mictyris. The first joint of the internal footstalk of the external palpi very large.

Genus XXIX. Doryppe. The four posterior feet placed on the back.

II. The posterior feet compressed.

* All the feet inserted in the same horizontal line.

Genus XXX. Orythia. The two posterior feet terminated with a swimming joint.

Genus XXXI. Matuta. All the feet, except the anterior pair, terminated by a swimming joint.

** The four posterior feet placed over the others.

Genus XXXII. Ranina. All the feet, except the anterior pair, formed for swimming.

TRIBE II. MACROURI.

Tail longer than the body; the apex furnished with moveable lamellæ, which are termed fins. Feet ten or fourteen.

Family IX. Pagurii.

The caudal, lamellæ, or fins, placed at a distance from the middle lamellæ, and not forming with it a fan-shaped fin.

1. Some of the feet formed for swimming, the last joint being compressed.

* Hands with one finger.

Genus XXXIII. Albunea. Posterior feet small and filiform. The three anterior pair compressed, and armed with a hook.

Genus XXXIV. Remipes. Arms shorter than the second pair of feet; the rest formed for swimming.

** Hands simple.

Genus XXXV. Hippa.

2. Hands with a finger and thumb. Feet not formed for swimming.

Genus XXXVI. Pagurus. Tail armed with hooked processes.

Family X. Palinurii.

The lateral lamellæ meeting the middle process, and forming with it a fan-shaped fin. Peduncle of the antennæ very long, armed at the apex with a jointed seta.

I. All the feet (arms included) terminated by a conic tarsus.

Genus XXXVII. Scyllarus. Exterior antennæ short and broad. Eyes distant.

Genus XXXVIII. Palinurus. Exterior antennæ very long and setaceous. Eyes placed on a common peduncle.

II. The two anterior feet, or arms, with a compound hand. Posterior feet spurious.

Genus XXXIX. Porcellana. Shell roundish-square.

Genus XL. Galathea. Shell oblong-oval.

Family XI. Astacini.

The lateral caudal lamellæ meeting the middle process, and forming with it a fan-shaped fin. The interior antennæ with a short peduncle, armed with jointed setæ.

I. Feet ten. Hands didactyle.

* Interior antennæ with two setæ.

A. Antennæ placed in the same horizontal line.

Genus XLI. Astacus. Six anterior feet compound.

Genus XLII. Thalasina. Four anterior feet compound.

Genus XLIII. Upogebia. Two anterior feet compound.

Genus XLIV. Callianassa. The four anterior feet compound; third pair monodactyle.

B. Exterior antennæ inserted below the interior ones, with a large squama at their base.

Genus XLV. Alphæus. The four anterior feet compound.

Genus XLVI. Penæus. The six anterior feet compound.

** Interior antennæ with three setæ.

Genus XLVII. Palæmon. The four anterior feet compound.

II. Hands monodactyle, or with a moveable hook.

Genus XLVIII. Crangon.

III. Feet more than ten. Hands simple.

Genus XLIX. Praunus.

Family XII. Squillarii.

Eyes pedunculated. The first joint in the body the largest.

Genus L. Squilla. Interior antennæ with three articulated setæ.

Genus LI. Mysis. Interior antennæ with two articulated setæ.

TRIBE III. GASTERURI.

Eyes sessile. The joint of the body which receives the head, of the same size with the rest.

Family XIII. Gnathonii.

Mandibules two, prominent. Antennæ nearly equal. Feet ten, all armed with a fixed nail. Tail with two moveable plates on each side, forming, with a middle process, a swimming tail.

Genus LII. Gnathia.

Family XIV. Gammarini.

Tail armed at its extremity with several styles. Feet fourteen. Tail not distinct from the body.

* Superior antennæ shorter than the peduncle of the inferior.

Genus LIII. Talitrus. Anterior pair of feet largest.

Genus LIV. Orchestia. Anterior pair of feet smallest.

** Inferior antennæ shortest.

Genus LV. Gammarus. The four anterior feet equal, furnished with a moveable nail. Superior antennæ with a seta on the third joint of the peduncle.

Genus LVI. Maera. Anterior feet with a moveable nail, the second pair with a compressed hand and moveable thumb.

Genus LVII. Melita. Anterior feet with a compressed hand furnished with a moveable thumb.

Genus LVIII. Leucothöe. Anterior pair of feet with a finger and thumb, the second pair with a moveable thumb.

Family XV. Corophionii.

Body elongated; tail with four bifid styles; feet fourteen, anterior pair with a moveable thumb. The under antennæ as long as the body, (feet-like.)

Genus LIX. Corophium.

Family XVI. Caprellini.

Body six-jointed; all the articulations except the second and third bearing feet. Two oars on each side, placed on the sides of the second and third joint.

Genus LX. Caprella. Body linear; oars globular.

Genus LXI. Cyamus. Body depressed; oars elongated.

Family XVII. Apseudii.

Body six-jointed; tail also six-jointed; the end armed with appendices. Feet fourteen; the anterior pair armed with a finger and thumb; second pair compressed and denticulated. Inferior antennæ bifurcated.

Genus LXII. Apseudes.

ORDER III. MYRIAPODA.

Body, with seven or more feet-bearing articulations. Antennæ, filiform, two or four in number. Palpi, single. Eyes, immoveable.

The animals which compose this order were placed in the class Arachnides, by Lamarck and Latreille; but, from the characters we have given in the introduction to this article, it is more correctly referable to Crustacea.

Observation. The animals of this order undergo no transformation; it has been stated, however, that some of the Scolopendrides increase the number of their feet during their growth: this Mr Leach denies, for, in his cabinet, most of the indigenous species may be seen, from the smallest size to the mature state, agreeing in all points with full grown specimens.

TRIBE I. TETRACERA.

Antennæ, four or two in number. Feet, fourteen. The anal segment of the body without feet, being sometimes armed either with lamellæ or styles.

Family XVIII. Asellides.

Antennæ generally very distinct, sometimes obscure; the internal or middle as long as the peduncle of the external ones. The last segment of the body generally largest.

I. The four antennæ very distinct.

* The foliaceous appendices of the tail very large, each one formed of a double scale; the two scales parallel and meeting together.

Genus LXIII. Asellus. Tail formed of one segment, with two bifid styles; the four antennæ setaceous, the outermost division being formed of a vast number of little joints.

Genus LXIV. Idotea. Tail formed of two or three segments, without styles; superior antennæ filiform, having four great divisions, the outermost composed of a great many smaller joints.

* * Foliaceous appendices of the tail formed of one or two processes, placed on a common peduncle situated on each side of the tail.

Crustacea.

A. Two processes on each side of the tail.

Genus LXV. Anthoura. Tail with two broad lamellæ on each side, and a middle process; antennæ short, the upper pair longest. Anterior pair of feet furnished with a moveable hook.

Genus LXVI. Cymothoa. Tail composed of many segments; the body not rolling into a ball; the feet armed with strong nails.

Genus LXVII. Sphæroma. Tail composed of two segments; body capable of rolling into a ball; the tarsal nail of a moderate size.

B. One process on each side of the tail.

Genus LXVIII. Nesæa. Peduncle of the superior antennæ large, and long; body six-jointed, the last joint largest.

Genus LXIX. Campecopea. Peduncle of the superior antennæ not large, but longer than the inferior; the process at the side of the tail long and curved.

II. The four antennæ obscure or wanting.

Genus LXX. Bopyrus.

Family XIX. Oniscides.

The internal antennæ very short and obscure.

Genus LXXI. Ligia. External antennæ terminated by an articulated seta.

Genus LXXII. Philoscia. External antennæ eight-jointed; the base naked; the first joints of the tail abruptly narrower than the last joints of the body.

Genus LXXIII. Oniscus. External antennæ with eight joints, inserted under the margin of the head.

Genus LXXIV. Porcellio. External antennæ with seven joints, inserted under the margin of the head; lateral styles of the tail conical and projecting.

Genus LXXV. Armadillo. External antennæ with seven joints, inserted in a fovea, in which the margin is elevated; lateral styles of the tail not projecting, terminated by a triangular joint; (body capable of rolling into a ball.)

TRIBE II. MILLEPEDA.

Feet above fourteen. Antennæ two. All the segments of the body, the anal, and head excepted, bearing feet.

Family XX. Julides.

The maxillæ adhering to the lip, or wanting. Palpi tuberculiform and obscure.

* Body crustaceous.

Genus LXXVI. Glomeris. Body elliptical, convex above, arched beneath; rolling itself into a ball when touched.

Genus LXXVII. Julus. Body oblong; eyes granular, and very distinct.

Genus LXXVIII. Polydesmus. Body long; eyes obscure.

** Body soft.

Genus LXXIX. Pollyxenus. Body oblong, terminated by a pencil.

Family XXI. Scolopendrides.

Two very distinct maxillæ, connected at their base. Maxillary palpi two, which are filiform. Labial palpi also two in number, terminated by a little hook (hamulus.)

I. Each segment bearing two pair of feet.

Genus LXXX. Scutigera.

II. Each segment bearing one pair of feet.

A. Antennæ conico-setaceous.

* Feet forty-two.

Genus LXXXI. Scolopendra. Eyes eight.

Genus LXXXII. Cryptops. Eyes obscure.

** Feet thirty.

Genus LXXXIII. Lithobius. Eyes granular.

B. Antennæ filiform.

Genus LXXXIV. Geophilus.

ORDER I. ENTOMOSTRACA.

Entomostraca.

Family I. Xiphosura.

Genera and species.

1. Limulus.

Genus I. Limulus. Shell coriaceous, of a rounded oval form, rather narrower behind than before, notched and flattened. Clypeus double. Shell divided, the anterior division the largest, somewhat moon-shaped, with three elevated ridges on the back. Eyes two in number, small, oval, and obscure, placed on the under side of the carinæ or ridges. Back carinated, with a deep sulcus or groove on each side. Tail horny, attached to the body by a hinge-like joint. No antennæ. Two double jointed, cylindrical mandibules, situated on the under part of the anterior division of the shell; the outermost digitated, furnished with a finger and thumb, the former being moveable. Feet ten, all (excepting the anterior pair, which are most frequently simple,) furnished with a finger and thumb. The branchiæ, or gill-like lungs, situated under a horny lamella on the sides of the body.

Sp. 1. *Polyphemus.* All the feet digitated; tail three-sided, frequently somewhat notched above; the middle carina of the anterior scutum spiny. Polyphemus.

Inhabits the ocean of South America, where it is well known to sailors under the name of *king-crab.*

Monoculus polyphemus of Linné.

Limulus cyclops of Fabricius.

Sp. 2. *Moluccanus.* All the feet digitated; tail three-sided, notched above from the base to the apex. The middle carina of the scutum without spines. Moluccanus.

A native of the East Indian ocean. Latreille, Gen. *Crust. et Ins.* tom. i. p. 11.—*Molucca crab.*

Sp. 3. *Heterodactylus.* The four anterior feet simple. Inhabits China. Heterodactylus.

Limule hétérodactyle. Lat. *Hist. Nat. des Crust. et des Insect.* tom. iv. p. 89.

Limulus heterodactylus of Latreille's *Genera Crust. et Ins.*

Sp. 4. *Virescens.* The anterior pair of feet simple. Inhabits the East Indian seas. Virescens.

Limulus polyphemus of Fabricius.

Observation. Limulus noctilucus, discovered by Captain Horsburgh, and described by James Macartney, Esq. in an ingenious paper on luminous animals, *Phil. Trans.* 1810, Plate xv. p. 292, evidently belongs to a distinct genus, at present unknown to us.

Family II. Pneumonura.

2. Caligus.

Genus II. Caligus. Shell heart-shaped. Two eyes placed at a distance from one another, on the anterior margin of the shell. Antennæ minute, setaceous. Mouth with a conic rostrum, which is bent downwards. Feet either eight or ten; two or four of which are furnished with an inflexed nail, and are formed for walking; the pair following these walking feet are armed with setæ, (sometimes with a double nail,) the rest bearing leaf-like lamellæ. Abdomen exserted, and nar-

Crustacea. rower than the shell, the apex armed with two round filaments.

Piscinus. *Sp.* 1. *Piscinus.* Body short; tail bifid, with one leaf-like process.

A very common species, attaching itself to various fish, especially the holibut (*pleuronectes hippoglossus*).

Caligus curtus of Müller. *Monoculus piscinus* of Fabricius and Linné. *Binoculus piscinus* of Otho Fabricius.

Oniscus lutosus of Slabber.

Productus. *Sp.* 2. *Productus.* Body elongated; tail with three laminæ.

Found on the same fish with the preceding; common on the cod.

Monoculus salmoneus of Fabricius. *Caligus productus* of Müller.

3. Argulus. Genus III. Argulus. Shell oval, plain, and membranaceous; in front with two contractions, notched behind. Eyes two, placed at a distance from one another, on the sides of the anterior edge. Antennæ two, in some four, of a very small size, composed of three joints, conic at their base, but gradually tapering towards the apex, inserted between the eyes. Mouth with a conic pectoral rostrum. Feet twelve; the anterior pair tubular, and somewhat hemispherical, by means of which the animal attaches itself to any body; the second pair conic, composed of four joints, notched at their base. The other four pair double jointed, and formed for swimming.

Argulus. *Sp.* 1. *Argulus.* Body greenish-grey.

Binocule du gastéroste, Geoffroy.

Argulus dephinus, Müller.

Monoculus argulus, Fabricius.

Monoculus gyrini, Cuvier.

Binoculus gasterostei, Latreille.

Argulus foliaceus of Jurine.

Inhabits fresh waters, adhering to tadpoles and fish of various kinds, as carp, tench, &c.

Observation. A most scientific paper on this species, *Argulus foliaceus,* is given by young Jurine in the *Annales du Muséum d'Histoire Naturelle* for 1806, in which he accurately describes its anatomical structure and economy. *Argulus charon* of Müller is merely the young of *Argulus foliaceus,* as has been shewn by young Jurine in the above mentioned paper.

Family III. Phyllopoda.

4. Apus. Genus IV. Apus. Body soft, covered either with a membranaceous or semi-crustaceous shell, of a roundish-oval shape, deeply notched behind. Two moon-shaped prominent eyes, placed very near each other, on the anterior part of the head. Antennæ hair-like and double jointed. Mandibules two, one on each side, nearly of a cylindrical shape, very short and hollow within, somewhat waved at the apex, and compressed; the extreme point notched. Four depressed, horny, transverse maxillæ, two on each side, placed under the mandibules. About sixty pair of lung-like feet. The tail elongate, somewhat conic, truncated at the end; composed of many very short and obscure joints.

Caneriformis. *Sp.* 1. *Caneriformis.* The dorsal carina blunt behind; no lamella between the caudal setæ.

Inhabits marshes and stagnant pools.

Limulus palustris, Müller.

Monoculus apus, Fabricius.

Apus cancriformis, Latreille.

Productus. *Sp.* 2. *Productus.* The dorsal carina spined behind; a lamella inserted between the caudal fins.

Found in the same situations as the preceding species. Is the *Monoculus apus* of Linné, well described by him in *Fauna Suecica,* ed. sec. p. 498. "*Cauda setis duabus validis, interjectâ lamellâ.*"

Family IV. Monophthalma.

5. Lynceus. Genus V. Lynceus. Eyes two. Antennæ two or four in number, setaceous or hair-shaped. Feet eight in number. Head exserted.

Brachyurus. *Sp.* 1. *Brachyurus.* Antennæ four; shell globose; tail deflexed.

Inhabits ponds and marshes.

Monoculus brachyurus of Fabricius.

Lynceus brachyurus of Latreille.

Sphæricus. *Sp.* 2. *Sphæricus.* Antennæ two; shell globose; tail deflected.

Inhabits ponds and marshes.

Monoculus sphericus of Fabricius.

Lynceus sphericus of Latreille.

6. Daphnia. Genus VI. Daphnia. Müller, Latreille. Eye one. Head exserted. Antennæ two, branched. Feet eight. (or twelve).

Pulex. *Sp.* 1. *Pulex.* Tail inflected; shell pointed behind.

Daphnia pennata of Müller.

Monoculus pulex of Linné and Fabricius.

Daphnia pulex of Latreille.

Pulex caudatus of Schæffer.

Inhabits Europe.

7. Cypris. Genus VII. Cypris. Muller, Latreille. Eye one. Head concealed under the shell. Antennæ setaceous, branched, and inserted above.

Conchacea. *Sp.* 1. *Conchacea.* Shell oval, transparent, and hairy.

Monoculus conchaceus, Linné and Fabricius.

Cypris pubera, Müller.

Cypris conchaceus, Latreille.

Inhabits fresh waters.

Detecta. *Sp.* 2. *Detecta.* Shell somewhat kidney-shaped, and transparent.

Cypris detecta, Müller.

Inhabits Europe.

Reniformis. *Sp.* 3. *Reniformis.* Shell kidney-shaped and green.

Cypris reniformis, Dardebart de Férussac, fils.

Inhabits France and Britain. First described by the son of Dardebart dé Ferussac, in the *Annales du Muséum d'Histoire Naturelle* for 1806. It has been taken in Duddingston Loch, near Edinburgh, and in various ponds in Devon, by Mr Leach. See Plate CCXXI, Fig. 2. Plate CCXXI. Fig. 2.

8. Cythere. Genus VIII. Cythere. One eye. Head concealed. Antennæ two, inserted above, and hairy.

Viridis. *Sp.* 1. *Viridis.* The shell green, kidney-shaped, and tomentose.

Cythere viridis, Mül. *Ent.* p. 64. tab. 7. fig. 1, 2; Latreille, *Gen. Crust. et Ins.* tom. 1. p. 19.

Cythérée verte, Latreille, *Hist. Nat. des Crust. et des Ins.* tom. iv. p. 252.

Monoculus viridis, Fab. *Ent. Syst.* tom. ii. p. 494.

Inhabits fuci and marine confervæ of the north of Europe.

Family V. Pseudopoda.

9. Cyclops. Genus IX. Cyclops. Müller, Latreille. Eye one. Body elongate, ovate-conical form. Antennæ two or four. Feet six or ten.

Quadricornis. *Sp.* 1. *Quadricornis.* Antennæ four; tail straight and bifid.

Monoculus quadricornis of Linné, Fabricius, Donovan.

Cyclops quadricornis of Müller and Latreille.

Inhabits ditches and gently running streams of water.

Amymones nauplii of Müller, is merely the young of this species, or of some other.

Longicornis.

Sp. 2. *Longicornis.* Two very long antennæ; tail bifid.

Monoculus longicornis, Fabricius.

Cyclops longicornis, Müller, Latreille.

Inhabits the Norwegian Sea.

Observation. The above species are very distinct and well marked; but we are sorry to inform our readers that this is not the case with the others, all of which inhabit fresh waters, but are by no means distinctly defined. The species alluded to are *Cyclops rubens, cœruleus, claviger,* and *mulleri.* On the latter, a long and elaborate paper is given in the *Annales du Muséum d'Histoire Naturelle* for 1806, but we have heard from good authority, that it has been described under another name in the works of Müller. We shall therefore be silent on the subject, and pass it without further notice.

Family VI. Cephalota.

* Eyes sessile.

10. Polyphemus.

Genus X. Polyphemus. Head distinct from the thorax. One eye. Thorax distinct from the abdomen, which is oval and crustaceous, compressed and crooked. Tail very much inflected. Two bifurcate processes extended horizontally. Eight short retuse feet, armed with setæ.

Oculus.

Species 1. *Oculus.* Body greenish-grey, oars blackish.

Inhabits marshes and lakes. Besides this, Mr Leach believes there are many other species which have been confounded with it: It is *Polyphemus oculus* of Müller and Latreille, *Monoculus pediculus* of Fabricius, *Cephaloculus stagnorum* of Lamarck.

11. Zöe.

Genus XI. Zöe. Head indistinct, with two large globose eyes. Rostrum nearly perpendicular, rather larger than the thorax, with the apex acute. Four antennæ inserted beneath the eyes; the interior simple, the exterior geniculated and bifid. Thorax somewhat oval. Back produced into a recurved spine twice as long as the thorax. Feet short, and hid under the thorax, with the exception of the hindermost pair, which are long, and formed for swimming. Tail, length of the thorax, and often inflected or bent up under it, composed of four joints; the first four very narrow, the last largest and lunated.

Pelagica.

Species 1. *Pelagica.* Colour cinereous.

Inhabits the sea every where.

Zöe pelagica, Bosc, *Hist. Nat. des Crust.* tom. ii. p. 135. *Monoculus taurus* of Slabber.

** Eyes with a distinct peduncle.

12. Branchiopoda.

Genus XII. Branchiopoda. Body filiform, and very soft. Head divided from the thorax by a very narrow but distinct neck. Two lateral moveable eyes. Two short, double-jointed, capillary antennæ, inserted behind and above the eyes. Front armed with two moveable tentaculæ or horns, (broader towards the apex in the male,) which are notched: those of the female jointed, and bearing a papilla on their point. In the front of the male, at the base of the tentaculæ, are two long hair-like filaments; the clypeus in this sex is double. In both sexes, the mouth has a hooked rostriform papilla, supported by four little processes. The trunk of the body keel-shaped, consisting of eleven joints, each bearing two branchial feet; the anterior pair with two, the posterior with three lamellæ. The tail about the length of the body, composed of six? or nine? obscure joints; the anal segment bearing two fins. The organs of generation situated at the base of the tail.

Stagnalis.

Species 1. *Stagnalis.* Body transparent, of a light-brown colour, slightly tinged with green or blue, particularly on the head and legs.

Cancer stagnalis of Linné and Shaw, *Gammarus stagnalis* of Fabricius, *Branchiopoda stagnalis* of Lamarck and Latreille, *Apus piciformis* of Schæffer.

A most ingenious and accurate paper has been written on this species by Dr George Shaw, in the *Transactions of the Linnean Society of London,* vol. i. of which we shall here avail ourselves.

"It is generally found in such waters as are of a soft nature, and particularly in those shallows of rain-water which are so frequently seen in the spring and autumn, and in which the *Monoculus pulex* of Linné, and other small animals, abound. At first sight, it bears some resemblance to the larva of a dytiscus; but when viewed closely it is found to be of a much more curious and elegant appearance than that animal. The legs, of which there are several pair (eleven?) on each side, are flat and filmy, and have the appearance of so many waving fins, of the most delicate structure imaginable. The whole animal is extremely transparent, and the general colour is brown, slightly tinged with bluish-green. These creatures should seem, by their appearance, to be of a predaceous nature, the structure of their fangs seeming to be particularly adapted to the purpose of seizing their prey; yet (Dr Shaw observes) I never observed those which I kept to attack any of the animalcules which were in the same water; on the contrary, *Monoculus conchaceus* of Linné very frequently assaults them, and adheres with such force to their tails or legs, as sometimes to tear off a part in the struggle. It delights much in sunshine, during which it appears near the surface of the water, swimming on its back, and moving in various directions, by the successive undulations of its numerous fin-like legs, and moving its tail in the manner of a rudder. On the least disturbance, it starts in the manner of a small fish, and endeavours to secrete itself, by diving into the soft mud. It changes its skin at certain periods, as is evident, from the exuviæ or slough being frequently found in the water in which these animals are kept.

Linné, as appears in the last edition of the *Fauna Suecica,* had observed this animal, but, though he particularly mentions the appearance of the ovarium, he proposes a most extraordinary doubt, whether it may not prove to be the larva of some species of ephemera. He repeats this question in the *Systema Naturæ.*

"In March and April, the females deposit their eggs without any settled order, and perfectly loose in the water. They appear to the naked eye like very minute globules of a light brown colour. Each ovum, when magnified, closely resembles the farina of a mallow. It is thickly beset with spines on every side, and coated over with a transparent gelatinous substance, reaching just to the extremities of the spines, and is most probably intended to assist in causing them to adhere to the substances on which they may chance to fall, or as a security from the attacks of smaller insects. In about a fortnight or three weeks, the eggs are hatched, and the young animals may be seen to swim with great liveliness, by means of three very long pair of arms or rowers, which appear disproportionate to the size of the animal, and indeed it bears in this very small state not much resemblance to the form it afterwards assumes; but, in the short space of a very few hours, the body assumes a lengthened form, and begins to acquire the tail-fin. The eyes in this state do not appear pedunculated. On the seventh day after hatching, they approach pretty nearly the form of the perfect animal; they, however, still retain the two first pairs of rowers or arms. The legs are at this period very visible. About the ninth day it loses the long oars, and appears still more like the animal in its advanced state." Its growth is but slow, and it is highly probable that a very considerable time elapses before the insect acquires its full size; but this the Doctor tells us he cannot presume to determine, as those he kept died before they had acquired any considerable size. When first hatched, they are scarcely larger than the common mite.

Cancer paludosus of Müller (*Zool. Dan.* p. 10, tab. 48, fig. 1.) is a distinct species, if his figure be correct. It differs in its tentacula and tail. Latreille thinks it very probable that *Cancer salinus* of Linné, and *Cancer paludosus* of Otho Fabricius, may also belong to this genus.

ORDER II. MALACOSTRACA.

FAMILY VII. CANCERIDES.

MALACOSTRACA.

A. The last joint of the hinder feet flattened, and formed for swimming.

13. PODOPHTHALMUS.

GENUS XIII. PODOPHTHALMUS. The peduncle, or footstalk, on which the eyes are placed, as long as the external angles of the shell.

Vigil.

Sp. 1. *Vigil.* Anterior claws, and external anterior angle of the shell, spiny.

A native of the shores of India.

Podophthalmus spinosus, Lamarck; *Portunus vigil*, Fabricius. (*Suppl. Ent. Syst.* 365.)

14. PORTUNUS.

GENUS XIV. PORTUNUS. The peduncle of the eyes much shorter than the anterior angle of the shell.

* Shell with more than five teeth on each side; hinder spine very long. Gen. *Lupa*, Leach's MSS.

Pelagicus.

Sp. 1. *Pelagicus.* The shell on each side with nine teeth, the posterior tooth largest; hands on the front feet angulated; the front with four equal teeth; two teeth-like processes are on each side, at the internal angle of the eyes.

Inhabits the sea every where, attaching itself to the Fucus natans, or floating tangle.

It is *Portunus pelagicus* of Fabricius; *Cancer pelagicus* of Linné.

See *Lupa* in Index.

Lupa pelagica, Leach's MSS.

** Shell with five teeth on each side; transverse much greater than the longitudinal diameter.

a Orbit of the eye behind, with one fissure. Gen. *Carcinus*, Leach's MSS.

Mænas.

Sp. 2. *Mænas.* Shell smooth, with five teeth on each side; clypeus with three rounded teeth or lobes. When alive green, mottled with black; hands with one tooth; wrists with a spine.

Inhabits the rocky shores of the European ocean, lurking under stones and tangle. Vast numbers are sold in London to the poor, who esteem them as great delicacies. The young, or fry, are frequently mottled or bordered with white.

Cancer mænas of Linné, Fabricius, Latreille, Pennant, &c.

b Orbit of the eye behind, with two fissures. Gen. *Portunus*, Leach's MSS.

1. Hinder nails with an elevated rib; wrists with two teeth.

Puber.

Sp. 3. *Puber.* Shell covered with a velvet-like down, five equal teeth on each side; the front beautifully denticulated; hands striated, with one spine on the upper side; wrists with two teeth.

Inhabits the Mediterranean and British seas.

This is *Cancer puber* of Linné; *Portunus puber* of Fabricius and Latreille; *Cancer velutinus* of Pennant.

This species, when alive, is a most beautiful animal. The anterior claws are mottled with blue and black; the eyes likewise exhibit a rich scarlet colour striped with blue. It is by no means uncommon on the rocky coasts of Devonshire, being found at low tide under stones and fuci. It is probably the species taken notice of by Aristotle, on account of the broad feet, which he says assist them in swimming, as webbed feet do the water fowl.

2. Hinder nails, with an elevated rib; wrists with one tooth.

Corrugatus.

Sp. 4. *Corrugatus.* Shell with transverse serrate-granulated lines, ciliated with hair; front with three short teeth, middle one largest; sides with five nearly equal in size; wrists with a sharp tooth.

Cancer corrugatus of Pennant.

Mus. Montagu.

Emarginatus.

Sp. 5. *Emarginatus.* Shell convex, with abbreviated lines of granules; sides with five teeth, the fourth smallest; front notched; wrists with a strong tooth.

Portunus emarginatus, Leach's MSS.

Discovered at Torcross; we have seen the female only.

Mus. Leach.

Arcuatus.

Sp. 6. *Arcuatus.* Front arcuated, in other respects exactly like *Portunus emarginatus.*

Mus. Sowerby, Leach. The female has not occurred.

Mr Montagu considers this as the male of *Portunus emarginatus.* Mr Leach thinks that *Emarginatus* may prove to be an accidental variety of this species; but considers the distinctions as too strong for usual sexual distinction.

3. Hinder nails without an elevated rib; wrists with one tooth.

Depurator.

Sp. 7. *Depurator.* The clypeus and shell on each side, with five nearly equal teeth; the wrists internally with a sharp spine; shell with oblique granulated lines; front with three teeth, middle one rather longest; hands above with one spine.

Inhabits the European ocean. It is found on all the shores of Great Britain, inhabiting water of twenty fathoms. It is well known to the fishermen under the name of flying crab, and is supposed by them (though erroneously) to destroy oysters, by insinuating its flattened hinder foot into the shell, when the animal opens for food.

Portunus depurator of Fabricius; *Cancer depurator* of Linné.

Lividus.

Sp. 8. *Lividus.* The clypeus with three teeth, middle one rather longest; shell on each side with five nearly equal teeth; hands above with one tooth; wrists internally with a sharp spine; shell smooth, and more depressed than in *Depurator*.

A single specimen was taken by Mr Leach at Newhaven, since which time he has seen another in the collection of Mr Montagu. The eyes are smaller, and the antennæ are shorter, than in *Portunus depurator.*

Portunus lividus, Leach's MSS.

Marmoreus.

Sp. 9. *Marmoreus.* Shell convex and smooth, with very obsolete granulations; front with three equal teeth, sides with five; hands smooth; wrists with one sharp tooth within.

Cancer pinnatus marmoreus, Montagu's MSS.

Portunus marmoreus, Leach; *Malacost. Brit.*; *Portunus*, Tab. A.

The shell, when alive, most beautifully marbled with red and white. Discovered at Torcross in the southern coast of Devon, by G. Montagu, Esq. where it is not uncommon.

*** Shell with five teeth on each side; longitudinal equal, or nearly equal, to the transverse. Orbit of the eye entire. Gen. *Portumnus*, Leach's MSS.

Variegatus. *Sp* 10. *Variegatus*. Shell somewhat triangular, with five teeth on each side. Three teeth on the clypeus, and one over each eye. Last joint of the posterior feet somewhat lanceolated.

Inhabits the sandy shores of Great Britain, and is esteemed a rare species. When alive, is of a yellowish white colour, mottled with purplish brown.

See *Portumnus*. Index.

Portumnus latipes, Leach's MSS.

Cancer latipes of Pennant.

Cancer latipes variegatus, Plane.

B. Hinder feet, as well as the rest, formed for walking.

15. Dromia. Genus. XV. Dromia. Hinder feet placed on the hinder part of the back. Shell very convex.

Rumphii. *Sp*. 1. *Rumphii*. Shell hairy, with five acute teeth on each side. Arms and feet smooth.

Inhabits the East Indies, and is the only species of the genus known.

Cancer dromia of Linné; *Dromia rumphii*, Fabricius and Latreille.

16. Calappa. Genus XVI. Calappa. Hinder angles of the shell arched, receiving the feet when contracted. Hands crested.

Tuberculata. *Sp*. 1. *Tuberculata*. Shell warty; the posterior angle with six wrinkled teeth; the posterior angle with two obscure teeth or spines.

A native of New Holland.

Calappa tuberculata of Fabricius.

Fornicata. *Sp*. 2. *Fornicata*. Posterior angles of the shell rounded and smooth.

Inhabits New Holland.

Caner calappa of Linné; *Calappa fornicata*, Fabricius and Latreille.

Granulata. *Sp*. 3. *Granulata*. Shell tuberculated, with the posterior angles spined, the hindermost spines very sharp and large; posterior margin notched a little at the base of the tail.

Inhabits the shores of the Mediterranean Sea, and is found at low tides lurking under fuci.

Cancer granulatus of Linné; *Calappa granulata* of Fabricius and Latreille.

17. Hepatus. Genus XVII. Hepatus. The second joint of the footstalk, or peduncle of the external double palpi, triangular, becoming gradually narrower towards the apex.

Fasciatus. *Sp*. 1. *Fasciatus*. Shell banded with brown.

Inhabits America.

Calappa angustata of Fabricius; *Hepatus fasciatus* Latreille.

18. Cancer. Genus XVIII. Cancer. Shell narrow behind. The second joint of the footstalk of the external double palpi quadrangular, notched at the apex internally, for the insertion of the following joint.

* Arms of the male considerably longer than those of the female.

Pagurus. *Sp*. 1. *Pagurus*. Shell on each side, with nine folds; the apex of the hand black.

Cancer pagurus of Linné, Fabricius, Latreille, and Pennant.

The common crab of our markets, the *Crabe pagure* of French writers, is in season between Christmas and Easter, and about harvest, and is esteemed the most delicious species of the genus. Its natural history is but little known. During summer, it inhabits all our rocky coasts, generally preferring twenty fathoms water. In the winter, it is rarely met with, during which time it is said to burrow in the sand. The tips of the claws were formerly used in medicine, to correct acidities in the stomach: this absurd practice is now deservedly rejected

It is taken in wicker baskets resembling a mouse trap, or in nets with large meshes, which are sunk to the bottom, and baited with garbage.

Sp. 2. *Incisus*. Back wrinkled. Sides of the shell with four obtuse teeth. Fingers black. Colour when alive florid. Incisus.

Cancer florridus of Montagu.

Cancer incisus of Leach, MSS.

Inhabits the shores of Europe. In Great Britain it is considered extremely rare, having been taken only by Mr Montagu, and Mr Leach, on the rocky coasts of Devon at low tides, where it is common.

Not *C. florridus* of Linné, which is an unknown species, as the description in the *Amœnitates Academicæ* will evince.

Mus. Leach, Montagu, Sowerby.

** Arms of the males not evidently larger than those of the female.

Sp. 3. *Hirtellus*. Body and legs hairy; the shell with five dents on each side; claws somewhat muricated on the outside. Hirtellus.

Inhabits the European ocean. In England it is esteemed a great rarity, having only been found hitherto on the coasts of Devonshire.

Cancer hirtellus, Pennant. *Bristly crab*.

Mus. Donovan, Leach, Montagu.

Sp. 4 *Spinifrons*. Shell smooth, with teeth on each side; the second and third teeth bifid; the front and claws with many spines. Spinifrons.

Inhabits the European ocean.

Cancer spinifrons of Fabricius, *Sup. Ent. Syst*. p. 339; and of Latreille.

Sp. 5. *Denticulatus*. Shell tuberose, with the sides spiny; clypeus with five teeth, the middle one longest, the basilar ones shortest; arms angulated. Denticulatus.

Inhabits England and Scotland.

Described and named by George Montagu, Esq. in the *Transactions of the Linnean Society of London*, vol. ix. from a specimen sent him by Mr Boys of Sandwich. He mentions having seen a Scotch specimen in the collection of Edward Donovan, Esq. F. L. S. &c. Lately taken in Devon by Mr Prideaux, an assiduous naturalist.

Genus XIX. Ocypode. Eyes with an elongated footstalk, inserted into the middle of the anterior margin of the shell. Shell rhomboidal, or heart-shaped. 19. Ocypode.

See *Gecarcinus* in Index.

Sp. 1. *Uca*. Shell somewhat truncate-cordate, with the sides abruptly convex; feet hairy; the tarsi with five or six elevated lines, which are rather warty; hands tuberculated with tufts of hair both above and below. Uca.

Cancer uca of Linné; *Ocypode uca* of Latreille.

Inhabits South America. Latreille.

We strongly suspect this to be the species commonly known by the name of land crab, of which Sloane, Catesby, and others, have given such detailed accounts. The following, selected from such authorities, may probably not prove unacceptable. "These animals live not only in a kind of orderly society in their retreats in the mountains, but regularly march once a year down to the sea side, in a body of some millions at a time, as they multiply in great numbers. They choose the month of April or May to begin their expedition, and then sally out by thousands from the stumps of hollow trees, which they excavate, from the holes which they dig for themselves under the surface of the earth, clefts of the rocks, and other hiding places. At that time, the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading on them.

"The sea is their place of destination, and to that they direct their march with the utmost precision. They never turn to the right or left for any obstacles that intervene, if they can possibly pass over them; and even if they meet with a house they will attempt to scale the walls. But though this be the general order of the route, they are upon other occasions obliged to conform to the face of the country; and if it is intersected with rivers, they are seen to wind along the course of the streams; but if only a small rivulet occurs, they force a passage across it. The procession sets forward from the mountains with the regularity of an army, under the guidance of an experienced commander. They are said to be commonly divided into three battalions, of which the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route and face the greatest dangers. They are often obliged to halt for want of rain, and to go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and then descend in regular order, being formed into columns of fifty paces broad, and three miles deep, and so close, that they almost cover the ground. Three or four days after this, the rear guard follows, a straggling undisciplined troop, consisting of males and females, but neither so robust nor so vigorous as the former. The night is the chief time of proceeding, but if it rains by day they do not fail to profit by the occasion; and they continue to move forward in a slow uniform manner. When the sun shines and is hot upon the surface of the ground, they halt and wait until the cool of the evening. When they are terrified, they march backward in a confused and disorderly manner, holding up their nippers. They try to intimidate their enemies by clattering their nippers together, as if it were to threaten those who come to disturb them. Their disposition is carnivorous, though they most commonly subsist on vegetables; for if, by any accident, one should get maimed in such a manner as to be incapable of proceeding, the rest fall on him and devour him on the spot, and then pursue their journey.

"After a march of sometimes two or perhaps three months, in this manner they arrive at their destined spot on the sea-coast, and then proceed to cast their spawn. The eggs are as yet within their bodies, and not excluded and retained, as is usual with animals of this kind, under the tail; for the creature waits for the benefit of the sea water to facilitate their exclusion. For this purpose, the crab has no sooner reached the shore, than it goes eagerly to the edge of the water, and lets the waves wash over its body two or three times. This has been thought necessary by some to ripen the spawn in the ovaria, as the crab appearing satisfied after a slight bathing, immediately retires, and seeks a lodging on the land. After this they say the spawn grows larger, is excluded from the body, and adheres to the ciliations under the tail. This bunch is seen as big as a hen's egg, and exactly resembling the roes of herrings. In this state of pregnancy they once more seek the shore for the last time; and shaking their spawn into the water, leave them to the chance of fortune and accident to bring them to maturity. At this time large shoals of hungry fishes are at the shore in expectation of this annual supply; the sea, to a great distance, seems quite black with them, and about two-thirds of the eggs are immediately devoured by those rapacious invaders. The eggs that escape are hatched under the sand, and soon after millions at a time of those little crabs are seen quitting the shore and slowly travelling up to the mountains. The old ones, however, are not so active to return; they have become so feeble and lean that they can hardly crawl along, and the flesh at the time changes colour. The greater part of them, therefore, are obliged to continue in the plains and lower parts of the country, until they recover, making holes in the earth which they cover with leaves and dirt, so as to exclude the light and air. In this cavity they throw off their old shells, which they leave behind them, as it were quite whole. At this time they are quite naked, and almost without motion for six days together, when they begin to grow fat, and are then most delicious eating. It is said they have under their stomachs four large white calcareous stones, which gradually decrease as in proportion the shell hardens, and when they come to perfection entirely disappear. Soon after this the animal is observed slowly making its way back, and all this is commonly performed in the space of six weeks. This animal, when possessed of its retreats in the mountains, is impregnable; for only subsisting on vegetables, it seldom ventures out; and its habitation being in the most inaccessible places, it remains for a greater part of the season in perfect security. It is only when impelled by the desire of bringing forth its young, and when compelled to descend into the flat country, that it is taken. At that time the natives wait for their descent in eager expectation of their arrival, and destroy thousands; but disregarding their bodies, they only seek for the small spawn which lies on each side of the stomach, within the shell, of about the thickness of a man's thumb. They are much more valuable on their return, after they have cast their shells; for being covered with a skin resembling soft parchment, almost every part except the stomach may be eaten. They are taken in the holes by feeling for them with an instrument; they are sought after by night, when on their journey, by flambeaux light. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most dreadfully whatever it happens to fasten upon. But dextrous crab-catchers take them by their hinder legs in such a manner that they cannot make use of their nippers, and thus throw them into their bags. Sometimes also they are taken when they take refuge in the bottoms of holes in rocks on the sea-side, by clapping a stick to the mouth of the hole, which prevents their getting out; and then soon after the tide coming, enters the holes, and the animal is found, upon the water retiring, drowned in its retreat.

"These crabs are of various colours: some are reddish, variegated with black; some yellowish, and others black, inclining to blue. Those of a light colour are esteemed most, and when full in flesh are well tasted. In some of the sugar islands they are eaten without apprehension of danger, and form no inconsiderable part of the food of the poor negroes."

They vary much in size; the largest grow to about

Crustacea. six inches wide; they walk sidewise. They are said to be poisonous, and to have killed several people who have eaten them, particularly the black kind. The lighter coloured varieties are most esteemed, and are frequently fattened for the table.

Ruricola. *Sp.* 2. *Ruricola.* Shell of a somewhat truncated heart-shape; with the sides very abruptly convex; the tarsi with six serrated elevated lines; hands smooth.

Inhabits South America, and most probably has the same habits with the preceding species, with which it has undoubtedly been confounded by many writers.

Cancer ruricola of Linné. *Ocypode tourlourous* of Latreille.

Cordata. *Sp.* 3. *Cordata.* Shell as in the two foregoing species, with the sides gently sloping; tarsi with four elevated lines, which are serrated.

Inhabits the same country with the two preceding species.

Cancer corpatus of Linné. *Ocypode cordata* of Latreille.

Ceratophthalma. *Sp.* 4. *Ceratophthalma.* Shell of a rhomboidal-square form; arms granulated; hands cordated; with the apex of the peduncles of the eyes produced beyond them into a smooth spine.

Inhabits the shores of the East Indies and Mediterranean.

Ocypode ceratophthalma of Fabricius and Latreille; *Cancer ceratophthalmus* of Pallas, and probably *Cancer cursor* of Linné.

Colour, when alive, light, prettily mottled with reddish brown. About sunset it comes up the shores and wanders about the strand, running at intervals with great velocity. The right claw is commonly larger than the left, and both are equally rough.

Vide Index, *Ocypode, Goneplat,* and *Gecarcinus.*

Vocans *Sp.* 5. *Vocans.*

This species, of which Linné has given a very imperfect character, is said to inhabit Jamaica, where it conceals itself under stones, and when caught emits a cry. It grows to the size of three inches in diameter.

Cancer vocans of Linné; *Cancer vocans major* of Herbst; *Ocypode maracoani* of Latreille.

Another species allied to this is figured by Herbst; it apparently differs in nothing but size from the above, and may probably be the young of it.

Angulata. *Sp.* 6. *Angulata.* Shell nearly quadrate; armed near the anterior angle with one spine, (sometimes two, one behind the other).

Colour red; eyes half the length of the shell. Arms of the male about five times the length of the body; those of the female only twice.

Inhabits the western coast of Britain. First noticed as British by Mr Pennant; it has since been taken in great abundance in Salcombe Bay, Devonshire, by George Montagu, Esq. F.L.S.

Cancer angulatus of Linné, Fabricius, and Pennant. *Ocypode bispinosa* of Lamarck; *Goneplat bispinosa,* Leach, MSS. *Vide Goneplat* in Index.

Mus. Donovan, Leach, Montagu, Sowerby.

20. Grapsus. Genus XX. Grapsus. Eyes with a short peduncle, inserted at the anterior angles of the shell, which is depressed and quadrangular. Interior antennæ hid by the clypeus, which is inflexed.

Pictus. *Sp.* 1. *Pictus.* Shell with four tooth-like folds in the anterior part; fingers concave at the apex; a strong tooth on the inner wrist.

Inhabits South America and the West India islands.

Cancer grapsus of Linné and Fabricius.

It is rather rare. The colour is whitish, variously but beautifully varied with red, or red spotted with white, sometimes with minute red dots and streaks on a white ground, the speckled appearance pervading the whole upper surface of the thorax and legs. The hand claws are comparatively very small, rough, and of a rufous colour, bordered with white; body beneath pale.

Obs. Cancer tenuicrustatus of Herbst, of which he figures a large and small variety, (probably the sexes), is merely a variety of this species.

Varius. *Sp.* 2. *Varius.* Front of the shell with four folds; arms short; the extremities of the fingers concave.

Inhabits the Mediterranean Sea.

Grapsus varius of Latreille, on whose authority it is here inserted.

Cruentatus. *Sp.* 3. *Cruentatus.* Front of the shell with four smooth folds; fingers conical; wrists tuberculated and spiny.

Inhabits South America.

Grapsus cruentatus of Latreille.

21. Plagusia. Genus XXI. Plagusia. Eyes with a very short peduncle affixed to the anterior angles of the shell, which is quadrangular. The anterior antennæ fixed into two little foveolæ on the upper part of the clypeus.

Clavimana. *Sp.* 1. *Clavimana.* Hands clubbed; shell depressed, with the front of the clypeus and sides of the shell with four teeth.

Inhabits the Indian ocean.

Plagusia clavimana of Latreille. *Seba Mus.* tom. 3. fig. 21.

Depressa. *Sp.* 2. *Depressa.* Shell depressed, the sides on each side with five, and the middle of the clypeus with two teeth; the tubercles on the back naked.

Inhabits the shores of the Mediterranean.

Cancer depressus of Fabricius; *Plagusia depressa* of Latreille.

Squamosa. *Sp.* 3. *Squamosa.* The tubercles on the back ciliated; the sides of the shell with five, and the middle of the clypeus with two, dentiform processes.

Its habitation is unknown.

Plagusia squamosa of Latreille.

Semicylindrica. *Sp.* 4. *Semicylindrica.* Shell elevated; sides without teeth.

Inhabits the Indian ocean.

Cancer semicylindricus of Fabricius; *Plagusia semicylindrica* of Latreille, who is of opinion that this species and *Cancer auritus* of Fabricius, (both species unknown to us), should constitute a distinct genus.

22. Pinnotheres. Genus XXII. Pinnotheres. Shell roundish square, or oval round. The internal double palpi joined at their base.

The animals of this genus inhabit bivalve shells; and some of the species were known to the ancients, who believed them to have been the consentaneous inhabitants of the pinnæ and other bivalve shells; which being too stupid to perceive the approach of their prey, were warned of it by their vigilant friend. Oppian tells the fable prettily:

> In clouded deeps below, the *pinna* hides,
> And through the silent paths obscurely glides;
> A stupid wretch, and void of thoughtful care,
> He forms no bait, nor lays the tempting snare;
> But the dull sluggard boasts a crab his friend,
> Whose busy eyes the coming prey attend:
> One room contains them, and the partners dwell
> Beneath the convex of one sloping shell;

Deep in the wat'ry vast the comrades rove,
And mutual interest binds their constant love;
That wiser friend the lucky juncture tells,
When in the gaping circuit of hill shells
Fish wandering enter; then the bearded guide
Warns the dull mate, and pricks his tender side;
He knows the hint, nor at the treatment grieves,
But hugs th' advantage, and the pain forgives;
His closing shells the *pinna* sudden joins,
And twixt the pressing sides the prey confines.
Thus fed by mutual aid, the friendly pair
Divide their gains, and all the plunder share.

Pisum. *Sp.* 1. *Pisum.* Shell orbicular, of a reddish colour; hands oblong.

Plate CCXXI. Fig. 3. Inhabits various species of mussels. In one hundred of *Mytilus modiolus*, Mr Leach found three of this species. Male unknown. See Plate CCXXI. Fig. 3.

Varians. *Sp.* 2. *Varians.* Shell of an oval-round, somewhat narrow in front, very convex, solid and marbled; hands oval; fingers arched. Female unknown.

Pinnothère des moules. Latreille *Hist. Nat. des Crust. et des Ins.* tom. vi. p. 83. pl. 48.

Cancer varians. Oliv. *Encycl. Meth. Hist. Nat.* t. vi. p. 155.

Pinnotheres mytilorum. Latr. *Gen. Crust. et Ins.* vol. i. p. 35.

It is highly probable that *Cancer pinnophylax* and *Pinnotheres* of Linné belong to this genus. They are unknown to all the naturalists of the present time. See *Pinnotheres mytili, modioli, pinnæ, pisum, varians,* and *mytilorum* in the Index, as we have obtained some interesting facts lately, respecting the genus and its species.

* *All the feet with conic tarsi.*

FAMILY VIII. OXYRHYNCHI.

Observation. It is very evident that *Cancer rhomboidalis* of Montagu (*Linnean Transactions*, vol. vii. tab. 6. p. 84.) belongs to this family, but is not referable to any genus hitherto established; and as a specimen of it has never come under our inspection, we shall describe it in his own words.

"*Cancer rhomboidalis*: with an uneven rough thorax, destitute of spines, but furnished with three large tubercles on the fore part, and two others near the tail: front, a broad thin concave plate, projecting into a long sharp-pointed proboscis: antennæ two, setaceous, longer than the proboscis: eyes vastly large, prominent, reticulated, pedunculated, nearly half the diameter of the thorax; arms large in proportion, smooth; on the first joint beneath, a hooked spine turning upwards; fangs toothed; legs eight, subulate, a long spine on the first joint of each, underneath; tail nearly as long as the body, slender, cylindric-depressed, formed with five joints; the end truncated, hirsute: colour, when alive, light olive-green. Length from the point of the proboscis to the end of the tail, a quarter of an inch. Found amongst *sertulariæ* or the back of *Cancer dodecos.*"

23. Leucosia. GENUS XXIII. LEUCOSIA. Shell somewhat oval and convex. (The greater part in most of the species smooth.) The double external palpi with equal narrow footstalks; the second joint narrowing towards the point, and reaching the anterior margin of the shell. *Antennæ and eyes minute.*

Nucleus. *Sp.* 1. *Nucleus.* The clypeus with two teeth-like processes in front: the posterior margin of the shell with two folds and a minute spine on the upper side; arms of an equal size and elongated.

Inhabits the Mediterranean Sea.

Cancer nucleus of Linné; *Leucosia nucleus* of Fabricius and Latreille.

Sp. 2. *Craniolaris.* Shell granulated; anterior part depressed above, posterior margin wrinkled, without spines; one tooth-like process in the middle of the clypeus; arms warty beneath; hands cylindrical and compressed; fingers conical, the internal side with sharp teeth. Craniolaris.

Inhabits the shores of Malabar.

Cancer craniolaris of Linné; *Leucosia craniolaris* of Fabricius and Latreille.

GENUS XXIV. MAIA. Shell nearly triangular, (generally rough and rostrated in front.) The internal footstalk of the external double palpi with two broad joints. Space between the eyes very wide. Feet nearly equal in size and shape: *the hinder feet being neither small nor spurious.* See *Ilyas Inachus,* in the Index. 24. Maia.

Division I. Arms very thick, and extending in a right angle.

Sp. 1. *Horrida.* Shell spinous, the upper surface very unequal and irregular: tail as if worm eaten; hand oval. Horrida.

Inhabits the Asiatic Ocean.

Cancer horridus of Linné; *Parthenope horrida* of Fabricius; *Maia horrida* of Latreille.

It is described by Petiver under the name of the great warty crab; is the *Rotskrabbe* of Rumphius, the *Die schreckliche* of Herbst.

For *Cancer horridus* of Pennant, see *Lithodes maja, Genus* 26.

Sp. 2. *Giraffa.* Shell spiny, with the spines branched: hind claws very long and tuberculated beneath. Giraffa.

Inhabits the East Indies.

Cancer giraff of Fabricius.

Sp. 3. *Muricata.* Shell unequal and hairy, with a double line and two dorsal spines on each side; marginal spines four; legs hairy. Muricata.

Habitat unknown.

Cancer muricatus of Fabricius. *Ent. Syst.*

Division II. Arms extended forwards, and not remarkably thick.

* Second pair of feet neither three times the length of the body, nor very slender.

Sp. 4. *Araneus.* Thorax rough and tuberculated; rostrum bifid; claws oval. Araneus.

Inhabits the European seas, frequenting all our sandy coasts, particularly the mouths of rivers, where it resides in deep water, and is taken by the oyster dredgers, who name it harper or spider crab; and, as they suppose it injurious to the beds, always bring it ashore and destroy it. It is very frequently covered with bernacles, alcyonia, sponges, fuci, and other marine substances. Its common size is about ten inches across from the tip of one arm to the other, but it sometimes measures sixteen from these points. The arms of the male are considerably longer than those of the female. It spawns during the greater part of the year.

Cancer araneus of Linné and Pennant.

Sp. 5. *Armata.* Shell of an elongated triangular form, hairy, with three dents behind; clypeus with two strong spines; hands elongated. Armata.

Màia armata of Latreille. *Inachus opilio* of Fabricius.

Inhabits the Mediterranean Sea.

Sp. 6. *Squinado.* Shell rough; the front with two spines, the sides with six elongated conic spiny processes: the arms scarcely longer than the following pair of feet; hands cylindrical and smooth; fingers tuberculated. Squinado.

Crustacea. *Cancer maja* of Scopoli. *Cancer spinosus*, Oliv. *Encycl. Method. Hist. Nat.* tom. vi. p. 173. *Maja squinado* of Latreille.

Inhabits the Mediterranean Sea.

To this division belong *Cancer asper*, *Dorsettensis*, and *Tetraodon* of Pennant's British Zoology.

** Second pair of feet very slender, and three times the length of the body.

Sagittaria. *Sp.* 7. *Sagittaria.* Rostrum very long, and surrounded by spines; feet spiny, arms elongate.

Maja sagittaria of Latreille. *Inachus sagittarius* of Fabricius.

Inhabits the island of Guadaloupe.

Phalangium. *Sp.* 8. *Phalangium.* Rostrum long and bifid, contracted at its base. Shell somewhat hairy, with three acute spines in the anterior part, obtuse tubercles behind: snout bifid.

Inhabits the northern seas, and is very abundant on many of our coasts, being frequently taken by the oyster dredgers, who imagine it to be the young of araneus.

Plate CCXXI. Fig. 4. *Cancer phalangium* of Pennant. *Leptopodia phalangium*, Leach's MSS. See Plate CCXXI. Fig. 4. and Appendix.

25. Macropodia. Genus XXV. Macropodia. Shell nearly triangular (unequal and rostrated in front;) external double palpi narrow and porrected: the second joint of the internal peduncle pretty long. Eyes distant: feet alike, *the hinder ones neither spurious nor minute.*

Longirostris. *Sp.* 1. *Longirostris.* Shell hairy, with three erect spines on the front; the hinder part with obtuse tubercles; rostrum bifid.

Cancer dodecos of Linné?

Inachus longirostris of Fabricius. *Macropus longirostris* of Latreille. *Macropodia longirostris*, Leach's MSS.

26. Lithodes. Genus XXVI. Lithodes. Shell nearly triangular and unequal, the anterior part rostrated. The external double palpi with narrow cylindrical footstalks. Eyes near each other at their base, but diverging above the shell. Hinder feet minute and spurious.

Maja. *Sp.* 1. *Maja.* Claws, feet, and shell spiny; rostrum spiny, with the apex bifurcate: flesh-coloured when alive.

Inhabits the northern and British seas. It is very rare in this country, being found only on the rocky coasts of Yorkshire and Scotland. It has been mistaken by Pennant for *Cancer horridus* of Linné, which we have already shown to belong to a distinct genus. *Vid. Gen.* 24. *Maia horrida.*

Cancer maja of Linné. *Inachus maja* of Fabricius. *Lithodes arctica* of Latreille. *Cancer horridus* of Pennant.

Mus. Donovan, Montagu, Neill, Leach, Fleming, Sowerby.

27. Corystes. Genus XXVII. Corystes. Shell somewhat oval. External antennæ porrected, as long as the body. The second joint of the internal peduncle of the external double palpi lengthened, and gradually narrowing towards the apex. Arms of the male three times the length of the body.

Cassivelaunus. *Sp.* 1. *Cassivelaunus.* Thorax rugulose, with four teeth on each side. Wrists with two or three spines. *Cancer cassivelaunus* of Pennant.

Inhabits all the sandy shores of our island, where it is frequently cast ashore, after a brisk gale of wind. Between the second and third spine, there is a small projecting process. Colour, when alive, flesh red.

Obs. Coristes longimanus of Latreille is merely the male of this species.

28. Mictyris. Genus XXVIII. Mictyris. Shell nearly oval, elevated, and truncated behind. Antennæ short. The basilary joint of the internal footstalk of the external double palpi very large. Arms at the base of the wrist jointed.

Longicarpus. *Sp.* 1. *Longicarpus.* Body nearly oval, thick, rather narrower in front, truncated behind, soft, and of a pale yellow colour. Length about nine lines. Shell with two longitudinal impressed lines; the anterior margin inflexed and rounded, and lateral external angles (as in some of the *Ocypodes*) produced into a tooth behind the eyes; the posterior margin ciliated with short black hairs. Eyes globular, with a short peduncle, placed under the anterior margin of the shell, (as in the *Ocypodes.*) Arms exserted forwards and downwards; the base of the second joint internally with a strong spine; the next joint triangular, the apex below being armed with three little processes. The wrist lengthened, somewhat arched, and hairy on the inside. Hand short, much compressed, with elevated lines. Fingers elegantly lengthened. Thumb with a strong single tooth. The other feet twice as long as the body, and much compressed; the tarsi furrowed and compressed; the second and first pair the largest, and nearly of an equal size.

Inhabits the East Indies. This rare and curious animal was first described by the French author Latreille, (whose system we are nearly following,) from a specimen in the Parisian Museum of natural curiosities. Our description is made from his, and the MSS. of Mr Leach, who described it from a specimen in the collection of the Royal College of Surgeons, London; and who had not seen Latreille's work at the time he drew up his description.

29. Dorippe. Genus XXIX. Dorippe. Shell somewhat oval, depressed, narrow before, and truncated. The four posterior feet dorsal; the last joints shortest.

Quadridens. *Sp.* 1. *Quadridens.* Middle of the clypeus with four teeth; those placed externally shortest. Sides of the shell with one tooth; the four anterior thighs somewhat notched.

Cancer lanatus of Linné; *Dorippe quadridens* of Latreille and Fabricius.

Inhabits the Mediterranean Sea, and figured by Plancus.

*** Some of the feet formed for swimming, the last joint being compressed and foliated.

30. Orithyia. Genus XXX. Orithyia. The two hinder feet alone formed for swimming.

Mamillaris. *Sp.* 1. *Mamillaris.*

Orythia mamillaris of Fabricius and Latreille, on whose authority we have inserted it here. They refer to a figure in *Herbst*, tab. 18. fig. 101.

Inhabits the Indian Ocean.

31. Matuta. Genus XXXI. Matuta. All the feet, with the exception of the brachia, inserted in the same horizontal line, and furnished for swimming.

Victor. *Sp.* 1. *Victor.* Shell punctured on all sides, but not striated behind.

Matuta victor of Fabricius and Latreille.

Inhabits the Indian Ocean.

Herbstii. *Sp.* 2. *Herbstii.* Shell with impressed dots; deeply striated behind.

Matuta Herbstii, Leach's MSS.

A new species, described in the manuscripts of Mr William Elford Leach, from a specimen in the British Museum, and named by him, after the celebrated crustaceologist Herbst, author of a large work in the German language, entitled *Von Krabben,* illustrated with correct plates.

Crustacea.

32. Ranina. Genus XXXII. Ranina. All the feet, except the brachia or arms, formed for swimming, two pair being placed above the others. Hand without the thumb; the finger much bent or arched; hands from the base to their extremities, gradually broader and much compressed.

Serrata. *Sp.* 1. *Serrata.* Arms very spiny; anterior margin of the shell with toothed lobes.

Cancer raninus of Linné and Fabricius; *Ranina serrata* of Latreille.

Inhabits the Indian Ocean.

Dorsipes. *Sp.* 2. *Dorsipes.* Anterior margin of the shell with seven teeth; the hands with a few tooth-like processes.

Cancer dorsipes of Linné; *Albunea dorsipes* of Fabricius; *Ranina dorsipes* of Latreille.

Family IX. Pagurii.

* Peduncle of the anterior antennæ much shorter than the two articulated setæ. Hands with one finger or none. Some of the feet formed for swimming, the last joint being compressed and leaf-shaped.

33. Albunea. Genus XXXIII. Albunea. Hands with one finger. Hinder feet minute, filiform, and spurious; the last joint of the other feet compressed and hooked.

Symnista. *Sp.* 1. *Symnista.* Anterior part of the shell smooth.

Cancer symnista, Linné; *Albunea symnista* of Fabricius and Latreille.

34. Remipes. Genus XXXIV. Remipes. Arms shorter than the second pair of feet; last joint hooked. The upper part rather convex. The feet, with the exception of those mentioned, formed for swimming.

Testudinarius. *Sp.* 1. *Testudinarius.* Shell about an inch in length, rather oval, of a reddish yellow colour, finely wrinkled; the anterior part with five teeth, the middle being shortest. Eyes placed on a very slender cylindrical peduncle, and inserted under the lateral teeth of the anterior margin. The middle antennæ somewhat bent backwards, ciliated with fine hair, and furnished with a thick peduncle. The exterior antennæ bent inwards under the others, with its peduncle flattened and jointed, having an elongated hairy footstalk.

Remipes testudinarius, Latreille; *Hippa adactyla* of Fabricius?

Inhabits New Holland.

35. Hippa. Genus XXXV. Hippa. Hands compressed, oval, and simple. The tarsus of the second and third pair of feet lunated; of the fourth triangular (rarely subquadrate); the posterior feet minute, spurious, and filiform.

Emeritus. *Sp.* 1. *Emeritus.* Tail inflexed; the last joint oval.

Cancer emeritus of Linné? *Hippa emeritus* of Fabricius and Latreille.

Inhabits the Indian Seas.

** Peduncle of the interior antennæ longer than the two articulated setæ. Feet formed for walking. The tarsi conic. Hands compound, furnished with a finger and thumb.

36. Pagurus. Genus XXXVI. Pagurus. This being the only genus of the division hitherto discovered, no generic character is necessary. All the species are parasitical, inhabiting the empty cavities of turbinated shells, the animals of which they are supposed to attack and devour, to gain possession of their shell. They change their habitation with their growth, first occupying the shells of the common periwinkle or trochus, then perhaps a nerite as large as a walnut, and after that a whelk. The tail is naked and slender, being covered only with a skin of very delicate texture; but it is furnished at the extremity with one or more hooks, by means of which it secures itself to the shell which it makes choice of. It is really astonishing with what facility these animals move, bearing at the same time the shell, which serves them as a covering, on their back. All the species are termed indiscriminately *Soldier-crabs* and *Hermit-crabs*, from the idea of their living in a tent, or retiring to a cell.

Crustacea.

Bernhardus. *Sp.* 1. *Bernhardus.* Arms hairy and rough, the right (generally) largest; hands somewhat heart-shaped; fingers broad. The appendix of the exterior antenna somewhat produced.

Cancer bernhardus of Linné and Pennant. *Pagurus bernhardus* of Fabricius and Latreille.

The common soldier-crab of our seas. It was not unknown to the ancients; Aristotle has very accurately described it under the name καρκίνιον.

A variety with equal claws sometimes occurs. It is considered by the vulgar as the young of the common lobster; it rarely exceeds six inches in length, from the tip of the claw to the tail.

Araneiformis. *Sp.* 2. *Araneiformis.* Resembling the foregoing species, but only one fourth its size.

Inhabits the shells of smaller univalve testacea. It is not uncommon in the Frith of Forth, where it was first observed by Charles Stewart, Esq. and described by him in a work entitled Elements of Natural History, under the name *Cancer araneiformis.* It differs from the foregoing species merely in size; and is considered by Mr Leach, who found several of them *in spawn* (at Porto-Bello near Edinburgh, after a hard easterly wind, and now has them in his collection) as the young of *Bernhardus;* most of the crustacea having the power of producing young before they attain their full growth.

Latro. *Sp.* 3. *Latro.* Shell at the suture four-cleft; tail simple and ventricose beneath.

Cancer latro of Linné.

Inhabits the East Indies, living in holes and cavities of rocks, from whence it wanders abroad in the night, and is said to climb cocoa-nut trees, in order to procure the fruit, which it throws down, and then descending tears them open with the two fore claws. The flesh is eaten by the natives after the entrails are removed, which they think poisonous. Probably referable to another genus.

Diogenes. *Sp.* 4. *Diogenes.* Hands rough and pubescent; left hand largest.

Pagurus diogenes of Fabricius. *Cancer diogenes* of Gmelin.

Inhabits the Indian seas, and is called by the natives *Gami na al Koona.* The general colour when alive is pale-testaceous, or yellow-brown.

"It is very diverting to observe this animal when about to change its shell, at which time it is seen busily parading the shore along that line of pebbles and shells which is formed by the extremest wave; still, however, dragging its own incommodious habitation at its tail, unwilling to part with one shell, even though a troublesome appendage, till it can find another more convenient. It is seen stopping at one shell, turning it and passing it by; going on to another, contemplating that for a while, and then slipping its tail from its old habitation to try on the new; this also is found inconvenient, and it quickly returns to its old shell again. In this manner it frequently changes, till at last it finds one light, roomy, and commodious; to this it adheres, though the shell be sometimes so large as to hide the body of the animal, claws and all. Yet it is not till after many trials and many combats also, that the soldier is thus completely equipped: for there is often a contest between two of them for some well-looking favourite shell for which they are rivals. They endeavour both to take possession; they strike with their claws, they bite each other till the weakest is obliged to give up the object in dispute. It is then the victor immediately takes possession, and parades in his new conquest three or four times back and forward upon the strand before his envious antagonist."

When taken, it is said to utter a feeble cry, endeavouring to seize the enemy with its nippers; which, if it fastens upon, it will sooner die than quit the grasp.

They frequent those parts of the sea-shore which are covered with shrubs and trees, producing various wild fruits, on which they subsist; though they will also feed on garbage of all kinds when much in want of food. When roasted in the shell they are esteemed delicate food.

Custos.

Sp. 5. *Custos.* Left claw largest; hand smooth; legs with very long smooth claws.

Pagurus custos of Fabricius, described by him from a specimen in the museum of Daldorff; much akin to the following species, but distinct.

Inhabits the East Indies.

Miles.

Sp. 6. *Miles.* Left hand largest; hand rough and tuberculated on each side; legs with very long serrated claws.

Pagurus miles of Fabricius.

Inhabits the East Indies.

Aniculus.

Sp. 7. *Aniculus.* Thorax ovate, ciliated at the sides; legs rugose and hairy.

Pagurus aniculus of Fabricius, described from a specimen in the Banksian cabinet.

Inhabits the South Seas.

Tubularis.

Sp. 8. *Tubularis.* Body nearly cylindrical; shell with excavated dots.

Cancer tubularis of Linné. *Pagurus tubularis* of Fabricius.

A native of the Mediterransan Sea, inhabiting the shell of *Serpula glomerata.*

Oculatus.

Sp. 9. *Oculatus.* Hands equal and rough; peduncles of the eyes as long as the thorax, with a small tooth at the base. Arms with a blood red spot on each.

Pagurus oculatus of Fabricius.

Inhabits the empty shell of *Murex brandaris,* and is about six inches in length when full grown.

latus.

Sp. 10. *Alatus.* Hands smooth, with three wing-like processes; right hand largest.

Pagurus alatus of Fabricius.

This species was discovered in Iceland by Dr Köenig. It is rather smaller than *Pagurus bernhardus*; under side of the wrist rugose.

Canaliculatus.

Sp. 11. *Canaliculatus.* Hands and wrists grooved, with elevated serrated margins; legs with hairy tufts.

Cancer canaliculatus of Herbst.

The habitat of this species is very doubtful.

Family X. Palinurini.

* The two anterior feet simple, with conic tarsi, rather larger than the others, but of the same form. Hand, without the finger. Exterior antennæ not inserted behind the eyes.

37. Scyllarus.

Genus XXXVII. Scyllarus. Exterior antennæ with broad squamiform joints, resembling a crest. Eyes distant.

Latus.

Sp. 1. *Latus.* Shell granulated; squamiform joint of the external antennæ entire.

Scyllarus latus of Latreille, who supposes it to be distinct from *Scyllarus australis* of Fabricius; and as this is the opinion of the London collectors also, we have followed him in giving the above name, and adopted it as a distinct species.

Australis.

Sp. 2. *Australis.* Plates of the antennæ roundish and smooth.

Discovered in the South Seas by Sir Joseph Banks, from whose collection Fabricius drew the above vague description; and as the plates of the antennæ were taken away by Fabricius, we cannot pronounce, with that degree of certainty we could wish, this to be really sufficiently distinct from *Scyllarus latus.*

Arctus.

Sp. 3. *Arctus.* Plates of the antennæ aculeated and hairy; the anterior part of the shell in front, with five spines.

Cancer arctus of Linné. *Astacus arctus* of Pennant. *Scyllarus arctus* of Fabricius and Latreille.

Inhabits the European ocean. It is rather larger than *Astacus marinus* (the common lobster). The shells are tuberculated, of a brown colour, spotted with yellow; legs spotted; thighs spinous.—It is very rare in England, if ever found on the coast, which we doubt.

Tridentatus.

Sp. 4. *Tridentatus.* Shell dentated above; the squamiform of the external antennæ with three strong teeth.

Its habitat is unknown. The above description was copied from the manuscripts of Mr William Elford Leach, who observed it in the collection of William Comyns, Esq. of Mount Pleasant, near Dawlish, Devonshire.

Observation. Fabricius has described three other species under this genus, which being unknown to British collectors, and unnoticed by other authors who have written on this branch of natural history, we can only describe them in the words of the author.

Antarcticus.

" *Sp.* 5. *Antarcticus.* Rough and hairy; thorax and plates of the antennæ serrated and ciliated. Inhabits India.

Æquinoctialis.

" *Sp.* 6. *Æquinoctialis.* Rough; thorax and plates of the antennæ wrinkled. Inhabits South America.

Orientalis.

" *Sp.* 7. *Orientalis.* Rough; anterior part of the thorax on each side armed with three spines. Inhabits the East Indies."

38. Palinurus.

Genus XXXVIII. Palinurus. External antennæ very long and setaceous. Peduncle of the eye transversely broad.

Vulgaris.

Sp. 1. *Vulgaris.* Spines placed over the eyes, which spines are dentated below; the segments of the abdomen with a transverse impressed line, which is interrupted in the middle.

Palinurus quadricornis of Fabricius. *Palanuris vulgaris* of Latreille.

Inhabits the Mediterranean Sea.

Homarus.

Sp. 2. *Homarus.* Thorax prickly on the anterior part, with two spines in front; base of the antennæ spinous.

Cancer Homarus of Linné. *Astacus homarus* of Fabricius.

Inhabits our rocky coasts, is taken for food, and commonly sold in London under the name of Thorny Lobster.

Astacus homarus of Pennant.

** Two anterior feet different from the rest, being furnished with a finger and thumb; hand compressed; hinder feet minute. Exterior antennæ inserted behind the eyes. The middle lamella of the tail either divided into two by a longitudinal groove, or the posterior margin notched.

39. Porcellana.

Genus XXXIX. Porcellana. Shell of a roundish square form. The internal side of the basilary joint of the internal footstalk of the external double palpi, dilated.

Hexapus.

Sp. 1. *Hexapus.* The anterior margin of the shell

Crustacea. with three wrinkled processes; the middle tooth being deeply notched. Arms smooth.

Cancer hexapus of Linné and Fabricius. *Porcellana hexapus* of Latreille.

Inhabits the European Ocean; is very common on our coasts, being frequently thrown ashore after a storm, adhering to the roots of *Fucus digitatus*.

Longicornis. *Sp.* 2. *Longicornis.* Clypeus with three wrinkled teeth, the middle tooth being entire. Arms striated.

Cancer longicornis. Linné.

Inhabits the European Ocean.

Platycheles. *Sp.* 3. *Platycheles.* Anterior margin of the shell with three entire teeth; the arms very large; the internal sides of the wrists with teeth; hands externally ciliated.

Cancer platycheles of Pennant, *Porcellana platycheles* of Latreille.

Inhabits the European Ocean.

It was discovered by Mr Pennant in Anglesea and the Hebrides, and described by him in his British Zoology. Some naturalists have supposed it to be *Cancer hexapus* of Linné. It is found on the coast of Devonshire at low tide, adhering to the under side of large stones.

40. Galathea. Genus XL. Galathea. Shell oval. The basilary joint of the internal peduncle of the external double palpi, neither plain nor dilated on its internal margin.

Strigosa. *Sp.* 1. *Strigosa.* Upper part of the hands, wrists, and arms ciliated with spines on every side: under side of the hands as if plaited; hairy between the fingers; rostrum with seven dents.

Cancer strigosus of Linné and Pennant. *Galathea strigosa* of Fabricius and Latreille.

Inhabits the European Ocean; is very common on several of our rocky coasts, being known by the name of *Plaited Lobster.* It is very active, and when taken, flaps its tail against its body with great violence and noise. Upper part when alive, brown inclining to reddish brown, with the sutures blue. Length six inches.

Squamifera. *Sp.* 2. *Squamifera.* Hands plaited, with their external margin spiny; wrists and arms plaited, internal margin armed with strong spines. Rostrum with seven dents.

Inhabits England.

Astacus squamifer. Montagu's MSS.

A new species discovered by Montagu on the south coast of Devon, where it is by no means uncommon. The above characters will point out their specific characters with sufficient accuracy. It has probably been confounded with *Galathea strigosa,* from which it is however very distinct. Length five inches.

Bamfia. *Sp.* 3. *Bamfia.* Thorax anteriorly wrinkled and spiny; rostrum with three teeth: arms very long and slender.

Galathea rugosa of Fabricius, *Astacus bamfius* of Pennant, *Cancer rugosus* of Gmelin.

Inhabits the European Ocean.

It was discovered in this country by the Rev. Mr Cordiner, near Banff, and sent to Mr Pennant; two others have since occurred on the same coast, which are preserved in the collections of Donovan and Sowerby. Length of tail and body five inches; arms six inches and a half.

Observe. Two other species are described under this generic title by *Fabricius,* but as they have never come under our inspection, we conceive it better to describe them in his words; as they may be referable to some other genus.

Gregaria. " *Sp.* 4. *Gregaria.* Thorax with ciliated plates; snout with three teeth; anterior feelers very long. *Fabricius.* Much smaller than the preceding species (*i. e. Galathea strigosa* and *rugosa.*)

" Inhabits the sea round Patagonia, where it occurs in such vast shoals that the sea appears perfectly red; that being the prevailing colour of them when alive: it has a brown spot on the back; hand claws rough. *Donovan.*

" *Sp.* 5. *Amplectens.* Thorax smooth; rostrum very short and notched; middle pair of legs very long. The body is small, whitish, and transparent, dotted with red. Thorax smooth, roundish behind, and broad, narrowing towards the front; four cetaceous antennæ, which are very long; abdomen of five segments; middle process or lamella of the tail tongue-shaped. Amplectens.

" This kind is luminous at night; it inhabits the Atlantic near the coast of Brasil." *Fabricius.*

Family II. Astacini.

Division 1. Hands compound, that is furnished with a finger and thumb.

* Antennæ inserted under the eyes, furnished with two articulated setæ.

Genus XLI. Astacus. Antennæ inserted in nearly the same transverse horizontal line; the peduncle of the exterior either supported by a small lamella or none. Six anterior feet compound; the anterior ones largest. The middle table of the swimming tail-fin broader at the base than at the apex. 41. Astacus.

In *A. gammarus* and *fluviatilis* the external antennæ are simple, in *Norvegicus* furnished with a scale at their external base: this last is considered as a distinct genus by Mr Leach, under the name of *Nephrops,* from the kidney shaped eye.

Sp. 1. *Gammarus.* Shell, tail, and feet, smooth, beautifully studded with minute excavated dots. Sides of the rostrum with four or more teeth, a strong tooth likewise at the base on each side. Eyes globose, or rather hemispherical. Hands with four, five, or six teeth on their internal margin. Tarsi beautifully ornamented with tufts of hair. Exterior lamella of the tail, at the junction of the accessory plate, with distinct obtuse spines. Ciliæ of the tail testaceous. Colour, when alive, purplish-black, often inclining to violet, elegantly mottled, (particularly on the under side,) with white; cream white and reddish. One claw always larger than the other; the fingers of one armed internally with minute teeth, of the other with tubercles. Gammarus.

Cancer gammarus of Linné. *Astacus gammarus* of Pennant. *Astacus marinus* of Fabricius and Latreille.

The middle lamella of the tail, in the *male* with the apex nearly straight, in the *female* rounded.

Inhabits the European Ocean; is the common lobster of our markets. It is found in great abundance on the north coast of Scotland, particularly amongst the Orkney Isles; but it is far more frequent on the coast of Norway, from whence the metropolis is well supplied at most seasons of the year, and these are generally preferred for the table.

Little can be said with regard to the natural history of the *lobster* beyond what has already been stated by Mr Pennant, and his friend Mr Travis of Scarborough. We shall therefore avail ourselves of the observations of these gentlemen, and detail at full length all they have remarked, but we cannot vouch for the perfect accuracy of all their observations.

" The habitation of this species is in the clearest water at the foot of rocks which impend over the sea. This has given opportunity of examining more closely into the natural history of this animal than many others, who live in an element that prohibits most of the human researches, and limits the inquiries of the most inquisitive: Lobsters are found on most of the shores of

Great Britain. Some are taken by the hand, but the far greater number in pots, a sort of trap formed of twigs, and baited with garbage, (called *kreels*) formed like a mouse-trap, so that when the lobster gets in, there is no return. These are fastened to cords and sunk into the sea, and their place marked by a buoy.

"They begin to breed in the spring, and continue breeding most part of the summer. They are highly prolific; Dr Baster counted 12,444 eggs under the tail of one female, besides those which remained in the body unprotruded. They deposit these eggs in the sand, where they are very soon hatched."

"Lobsters change their crust annually, and previous to their putting off their old one, they appear sick, languid, and restless. They totally acquire a new coat in a few days; but during the time they remain defenceless, they seek some very lonely and remote place, lest they should be devoured by such of their brethren as are not in the same weak situation." *Pennant.*

They are exceedingly voracious animals, and feed on all sorts of dead bodies, sea-weeds, or garbage.

Some very interesting particulars were communicated to Mr Pennant by Mr Travis, from a variety of observations made by himself on the coast of Scarborough. "Lobsters," he observes, "are found in great abundance and very fine on that coast. The larger ones are in general, in their best season, from the middle of October till the beginning of May. Many of the small ones, and some of the larger sort, are good all the summer. They are, in general, from four to four inches and a half from the tip of the head to the extremity of the back shell. Commonly the pincers of one of the lobster's large claws are furnished with knobs, and those of the other serrated; with the former, it keeps firm hold of the stalks of submarine plants, and with the other it cuts and minces its food very dexterously. The knobbed or numb-claw, as the fishermen sometimes call it, is sometimes on the right side, and sometimes on the left indifferently. It is more dangerous to be seized by them with the cutting claw than the other, but in either case, the quickest way to get disengaged, is to pluck off the creature's claw; a new one will be produced in its place, though it will never attain the size of the former. The female or hen lobster, does not cast her shell the same year that she deposits her ova, or in the common phrase, *her berry*. When the ova first appear under her tail, they are very small, and extremely black, but they become in succession almost as large as ripe elder berries before they are deposited, and turn of a dark brown colour, especially towards the end of her depositing time. They continue full and depositing the ova in constant succession as long as the black substance can be found in their body, which, when boiled, turns of a beautiful red colour, and is then termed coral. Hen lobsters are found in berry all the year. It is a common mistake that a berried hen is always in perfection for the table. When her berries appear large and brownish, she will always be found exhausted, watery, and poor. Though the ova be cast all the year round, they seem only to come to life during the summer months of July and August. Great numbers of them may be then found under the appearance of *tadpoles* swimming about the little pools left by the tide amongst the rocks, and many also under their proper form, from half an inch to four inches in length.

"In casting their shells, it is hard to conceive how the lobsters are able to draw the flesh of their large claws out, leaving the shell entire and attached to their body; in which state they are constantly found. The fishermen say the lobsters pine before casting their shell, till the flesh of its large claw is no thicker than a goose quill, which enables them to draw its parts through the joints and narrow passages near the trunk. The new shell is quite membranaceous at first, but hardens by degrees. Lobsters only grow in size whilst their shells are in a soft state. They are chosen for the table by their being heavy in proportion to their size; and by the hardness of their shells on the sides, which, when in perfection, will not yield to moderate pressure. Barnacles, and other marine animals adhering to them, are esteemed certain indications of superior goodness. Cock lobsters are in general better than the hens in winter; they are distinguished by their narrow tails, and by having a strong spine upon the centre of each of the transverse processes beneath the tail, which support the four middle plates of the tails. The flesh of the lobster's claw is more tender and delicate than that of the tail. The Scarborough fishermen do not take them in pots or kreels, as is usual in still and deep waters; they use a bag-net, fixed to an iron hoop, about two feet in diameter, and suspended by three lines like a scale. The bait is usually fish-guts tied to the bottom and middle of the net. They can take none in the day-time except when the water is thick: they are most frequently taken at night, but even then it is not possible to take any when the sea has a luminous appearance: (This is accounted for, by James Macartney, Esq. in a paper given by him to the Royal Society, and published in the Philosophical Transactions for 1810, p. 292.) In summer, the lobsters are found near the shore, and thence to about six fathoms water; but in winter, they are seldom taken in less than twelve or fifteen fathoms. Like insects, they are much more active and alert in warm than in cold weather. In the water, they can run nimbly on their legs or small claws, and if alarmed, can spring tail foremost, to a surprising distance, as swift as a bird can fly." (This observation has been confirmed by that indefatigable observer of nature, Patrick Neill, Esq. secretary to the Wernerian and Horticultural Societies of Edinburgh, who, in a tour made by him to the Orkney Isles, says they skimmed along the surface of the sea with amazing rapidity as the boats approached the shore.) "The fishermen can see them pass about thirty feet, and by the swiftness of their motions, suppose they may go much farther. When frightened, they will spring from a considerable distance to their hold in the rock; and what is not less surprising than true, they will throw themselves into their holds in that manner through an entrance barely sufficient for their bodies to pass; as is frequently seen by the people who endeavour to catch them at Filey Bridge. In frosty weather, if any should happen to be found near the shore, they are quite torpid and benumbed."

Immense numbers of lobsters are annually sent to London from the Orkney Isles. Pennant mentions, in his Tour to Scotland in 1772, that 60,000 or 70,000 are yearly sent from Montrose alone. They are said to fear thunder, and to cast their claws on a great clap; it is said they will do the same on the firing of a great gun; and that when men of war meet with a lobster boat, a jocular threat is used, that if the master does not sell good lobsters, *they will salute him.* When frightened or irritated, they frequently throw off their claws; the same thing happens when the poor animals are plunged into the boiling pot for dressing. When first caught, if only taken by one claw, they will throw it off and so effect their escape.

The circumstance of the reproduction of their claws, though surprising, is nevertheless true; lobsters as well as crabs will renew their claws, if by accident they should be torn off, within the space of a few weeks after the mischief has happened.

A small lobter, according to Mr Pennant, differing in nothing but size from the above, is found near Llyn in Caernarvonshire, where it burrows in the sand; from which last circumstance, we suspect it to be distinct, and well worth the examination of any naturalist who may happen to visit that place.

The lobster was well known to the ancients, and is well described by Aristotle, under the name *αστακος*.

Fluviatilis. *Sp.* 2. *Fluviatilis.* Rostrum toothed. Hands tuberculated.

Cancer astacus of Linné. *Astacus astacus* of Pennant. *Astacus fluviatilis* of Fabricius and Latreille.

Inhabits the rivers of Europe, especially such as have a clayey bottom. It is the common *craw-fish* of English writers, and is much esteemed as food. They excavate holes for themselves in the banks of rivers in which they live, only coming abroad at night in search of food, which consists of vegetable as well as animal matters; they are taken by means of nets, which are spread across the waters which they frequent, or by the hand. Colour, when alive, dark brown approaching to black.

Norvegicus. *Sp.* 3. *Norvegicus.* Rostrum acute, with many spines on each side; shell somewhat spiny in front; from which three longitudinal ridges arise. Hands angular, the angles tuberculated. Wrists spiny. Eyes kidney-shaped. Tarsi hairy. Accessory process of the tail at the base acutely spined. Tail elegantly marked with smooth and short-haired spaces placed alternately.

Cancer norvegicus of Linné. *Astacus norvegicus* of Pennant. *Nephrops norvegica,* Leach's MSS.

Inhabits the northern parts of Europe; is found in the Frith of Forth during the summer months, often attaching itself to the lines of the fishermen. Like the common lobster, it has one claw large, the other small; a variety with equal claws sometimes occurs. Colour, when alive, flesh red.

42. Thalassina. Genus XLII. Thalassina. Antennæ inserted in nearly the same horizontal line. The four anterior feet compound, the first or front pair largest.

Scabra. *Sp.* 1. *Scabra.* Shell oval, sides compressed, and spiny. Back with two longitudinal furrows, one on each side; these converge towards the posterior margin, and include another very deep groove. Tail cylindrical, a little longer, and much narrower than the shell; composed of six segments (not including the fin) very convex above, with the lateral margin dilated, wrinkled, and rounded; the first five with an elevated carina or ridge, the fin segment with narrow, acute, and sharp appendices. The feet compressed, with the posterior and anterior margins denticulated; the four anterior feet ciliated with hairs; right arm largest; hands oval, and tuberculated, with teeth above and below; the thumb compressed and rounded. This genus was instituted by the illustrious Latreille, in his work entitled *Genera Crustaceorum et Insectorum,* who describes the above species from a specimen in the museum of natural history in Paris. Mr Leach has compared this description with a specimen in the Hunterian museum, and from his manuscript we have inserted the above account, which differs but little from that given by Latreille.

43. Upogebia. Genus XLIII. Upogebia. Antennæ inserted in nearly the same horizontal line. Eyes pedunculated, and concealed under the proboscis. Abdomen composed of quadrate crustaceous joints. Anterior feet compound, being furnished with a very long moveable thumb; feet compressed, decreasing in size, the anterior being largest. Middle process of the tail nearly quadrate, the apex being scarcely narrower than the base.

Stellata. *Sp.* 1. *Stellata.* Thorax smooth behind, the anterior part set with minute spines disposed in longitudinal rows, anterior part terminating in a broad and rough rostrum, on each side of which at the base is a strong spiny spire. Under part of the hands hairy, fingers very sharp; wrists and arms angulated, and set with hairs beneath and inside. Feet somewhat compressed. Extremity of the middle process of the caudal fin slightly notched; moveable processes, with an elevated ridge, in the middle. Length two inches. Colour yellowish white, covered with minute yellow or orange spots.

Cancer stellatus, Montagu; *Upogebia stellata,* Leach's MSS.

This animal was discovered by George Montagu, Esq. and described by him in the ninth volume of the *Linnean Transactions.* It is very rare, and inhabits the subterraneous passages made by the solenes, or rasor shells.

44. Callianassa. Genus XLIV. Callianassa. Antennæ placed in nearly the same horizontal line; the peduncle of the exterior with four joints, and a seta three times as long as the peduncle; the footstalk of the interior antennæ with three joints, and a jointed seta a little longer than the peduncle. A large scale attached to the base of the internal antennæ above. Abdomen with six membranaceous joints. Feet compressed; the two anterior pair compound, the third pair with a simple moveable thumb; hands of the anterior pair jointed; wrist entire. The middle process of the tail triangular, with the point very sharp.

Subterranea. *Sp.* 1. *Subterranea.* Thorax smooth and membranaceous, the anterior part crustaceous above. Claws unequal; the larger one very smooth, with the margin and fingers ornamented with tufts of hair; inner side of the thumb denticulated; wrist triangulated, with the margins toothed, armed at the base with a hooked process; arm angulated, denticulated beneath: smaller claw with oblong, oval, and somewhat hairy fingers, the arms and wrists being simple, and not angulated. The second pair of feet with hairy fingers, and an ovate hand; the third with a moveable thumb, very much compressed and ciliated; the fourth and fifth simple, with compressed hairy tarsy.

Cancer astacus subterraneus, Montagu, *Lin. Trans. Callianassa subterranea* of Leach's MSS.

This singular animal was discovered by Mr Montagu, whilst digging for *Solen vagina* in a sand bank in the estuary of Kingsbridge, on the south coast of Devon, about two feet beneath the surface. He informs us that they are rare, but that a sufficient number has been taken, to shew that the larger claw is not constant to one side. The females are very rare. Length about two inches.

Mus. Montagu, Sowerby, Leach, Prideaux.

45. Alphæus. Genus XLV. Alphæus. The exterior antennæ situated lower than those of the middle, with a large scale attached to the peduncle, (this scale being generally notched on the external side of the point.) The four anterior feet compound. Wrists of the second pair jointed. Middle process of the tail of an oblong-triangular shape, the apex much narrower than the base.

* The anterior larger than the second pair of feet.

Avarus. *Sp.* 1. *Avarus.* Hands unequal and difformed; rostrum short and subulated.

Alphæus avarus of Fabricius and Latreille.

** The second pair of feet larger than the first.

Crustacea.

Flavescens. *Sp.* 2. *Flavescens.* Body entirely yellow.

Alphæus flavescens of Latreille.

Marmoratus. *Sp.* 3. *Marmoratus.* Body pale rufous, mottled with red.

Alphæus marmoratus of Latreille.

This and the foregoing species inhabit the East Indian ocean, and are described by Latreille, from specimens in the French museum of natural history, and on his authority we introduce them here.

46. Penæus. Genus XLVI. Penæus. The exterior lower than the internal antennæ, with a scale attached to the peduncle, (often notched on the external side of the apex). The six anterior feet compound; the anterior pair shortest. Middle process of the tail-fin oblong-triangular, the apex much narrower than the base.

Monodon. *Sp.* 1. *Monodon.* Rostrum porrected, and turning upwards; serrated above, armed with three teeth below.

Penæus monodon of Fabricius and Latreille.

Observe. To this section another genus (not hitherto defined by any author) seems to belong, which contains *Cancer astacus gibbosus* of Montagu. *Lin. Trans.* vol. ix. pl. 5. fig. 1. But as we have never seen perfect specimens, we refrain from attempting a generic character, which must necessarily be very defective. We shall therefore describe the animal in Montagu's own words.

" Body slender, incurvated, with six joints. Thorax smooth. Proboscis long, laterally compressed, and serrated; a small spine on each side the proboscis, and another beneath each eye. Antennæ four; upper pair shortest and bifid; lower pair single, nearly as long as the body. Two anterior ciliated plates. Eyes pedunculated. Arms and legs scarcely definable; the anterior pair is terminated by a quadrifid joint; the second pair is cheliform, the other three pair appear when magnified to have a toothed claw. Besides these, there are two very long and slender appendages, which do not strictly appear to be legs, but seem to be auxiliary to the palpi, though they originate so far from the mouth, for they are always placed forwards towards the mouth; these are slightly chelate. The caudal fins are similar to those of the prawn, with a slight spine near the end of the exterior pair. Colour, when alive, red. Length about an inch. Not unfrequently taken by dredging at Torcross, Devonshire." See *Hippolyte* in the Index.

** Interior antennæ with three setæ.

47. Palæmon. Genus XLVII. Palæmon. Four anterior feet compound.

A. Anterior pair smaller than the second.

Squilla. *Sp.* 1. *Squilla.* The rostrum acute, and turning upwards; the superior part with seven teeth, longer than the peduncle of the internal antennæ.

Cancer squilla of Linné. *Astacus serratus* of Pennant. *Palæmon squilla* of Fabricius and Latreille.

Inhabits the European ocean, frequenting most of our shores, lurking amongst loose stones and algæ, in pools left by the tide, where it is taken by means of a small net fixed to a hoop. It is the common prawn of our markets. When alive, cinereous, elegantly banded with brown; but by boiling, it acquires a fine red colour. Pennant says, that it is frequently taken over thirty fathoms depth of water, but we have never observed it in such a situation. Length five inches.

Varians. *Sp.* 2. *Varians.* Rostrum straight, a little longer than the peduncle of the middle antennæ, with four teeth in the upper side.

Palæmon varians, Leach's MSS.

A very common species on the Devonshire and Glamorgan coasts, where it is taken and sold under the name of shrimp. It may possibly be *Astacus squilla* of Pennant, but the descriptions of that author are so laconic, that we are in great doubt in this as in various other instances. Length two inches and a half or three inches.

B. Anterior larger than the second pair of legs.

Sp. 3. *Nitescens.* Rostrum without teeth. Nitescens.

Cancer astacus nitescens of Montagu. *Athanas nitescens*, Leach's MSS.

Found on the southern coast of Devonshire by Col. Montagu. Length one inch, or rather less.

Division II. Hands without the finger, having only a moveable thumb.

Genus XLVIII. Crangon. Anterior pair of feet largest, and furnished with a moveable thumb; the other four pair unequal and simple. 48. Crangon.

Sp. 1. *Vulgaris.* Shell smooth, rostrum short, with a single groove above. See Plate CCXXI. Fig. 5. Vulgaris. Plate CCXXI. Fig. 5.

Cancer crangon of Linné. *Astacus crangon* of Pennant. *Crangon vulgaris* of Fabricius and Latreille.

Inhabits all the sandy shores of the European ocean; is the common shrimp of the English markets. Its colour when alive is cinereous, inclining to transparent, beautifully mottled and spotted with brown and blackish-brown.

Division III. All the feet simple, having neither finger or thumb.

Genus XLIX. Praunus. Legs on each side fourteen, set in a double series at the sides of the thorax. Female furnished with a pouch, situated at the base of the abdomen, in which she carries her young after their exclusion from the egg. 49. Praunus.

This genus was instituted by Mr Leach, who has derived the name from the English word *prawn*.

Sp. 1. *Flexuosus.* Middle process of the tail-fin deeply notched. Flexuosus.

Cancer flexuosus of Müller. *Cancer multipes* of Montagu. *Lin. Trans.* vol. ix. tab. 5. fig. 3. *Praunus flexuosus*, Leach's MSS.

Discovered as an inhabitant of Britain by Mr Henry Boys of Sandwich. It has since been observed by Mr Montagu on the south coast of Devon, and accurately described by him in the ninth vol. of the *Linnean Transactions.* As he never saw it alive, the following account, extracted from Mr Leach's MSS. may not prove uninteresting.

" Colour when alive pellucid-cinereous. Eyes black, red at their base. Laminæ of the head with a black longitudinal line, and spots. A clouded spot on each side the hinder part of the thorax, and another above the legs. Every segment of the body above beautifully marked with a reddish rust-coloured spot, disposed in an arborescent form; tail-fin spotted with the same colour, mixed with black. Pouch of the female with two rows of fuscous-black spots. Under side of the abdomen regularly mottled with rufous-black. It is found with fry from the middle of June to the middle of July. Females one-third more abundant than the males." Mr Leach observed them in great abundance in pools left by the tide in the Frith of Forth near Leith. Length an inch and a quarter."

Sp. 2. *Integer.* Middle process of the tail entire and not notched. Integer.

Praunus integer, Leach's MSS.

This species was discovered by Mr Leach at Loch-Ranza, Isle of Arran, in brackish pools left by the tide, in the month of August, in the greatest abundance. The females were with young, and the males were more abundant than the females. Like the foregoing species, it swims with its head uppermost, having a most grotesque appearance. Colour when alive, pellucid, cinereous, spotted with black and reddish-brown, varying much in their position. Mr Leach confesses, that he did not at first conceive it to be distinct from *Praunus flexuosus*, but on examination found that they not only differed in size, but most essentially in the middle process of the tail-fin. Length a third of an inch.

Family XII. Squillarii.

50. Squilla. Genus L. Squilla. Interior antennæ with three articulated setæ. Two large arms. Ten feet, with an hooked hand; the other six simple.

Mantis. *Sp.* 1. *Mantis.* Upper part of the body with several elevated longitudinal lines; thumbs with six dents.

Inhabits the Mediterranean and Asiatic seas.

Cancer mantis of Linné. *Astacus mantis* of Pennant? *Squilla mantis* of Fabricius and Latreille.

This species has been introduced into the *British Fauna*, but the authority is questionable.

51. Mysis. Genus LI. Mysis. Interior antennæ with two articulated setæ. Arms small. Twelve feet, all armed with a claw, and formed for swimming.

Saltatorius. *Sp.* 1. *Saltatorius.*

Cancer pedatus of Otho Fabricius. *Mysis saltatorius* of Latreille.

Inhabits the Greenland Sea.

This genus is introduced from the *Genera Insectorum et Crustaceorum* of Latreille, who owns that he has never examined the species himself, but has admitted it into his work solely on the authority of Otho Fabricius.

Family XIII. Gnathionii.

52. Gnathia. Genus LII. Gnathia. Mouth with two strong porrected mandibules or jaws, concave above, convex below. Antennæ setaceous; the upper pair rather longest. Feet ten, all armed with a nail. Tail jointed, and furnished with a swimming tail, as in the family Astacini.

Termitoides. *Sp.* 1. *Termitoides.* Mandibules on the inner side armed with minute teeth; middle process of the tail triangular, apex acute.

Cancer maxillaris of Montagu.

Gnathia termitoides, Leach's MSS.

Inhabits the British Ocean, but is not common.

Mr Leach suspects, that *Oniscus cœruleatus* of Montagu, *Lin. Trans.* vol. xi. is the female of this animal.

Family XIV. Gammarini.

1. Superior antennæ shorter than the peduncle of the inferior antennæ. Feet fourteen.

53. Talitrus. Genus LIII. Talitrus. Anterior pair of feet larger than the second pair; no hands.

Observe. The animals of this genus are familiarly known under the name of *sandhoppers*, and cannot have escaped the observation of the most cursory observer, multitudes being seen, during the summer, on all our sandy shores, skipping about in all directions in the evening. Their use in the economy of nature appears to be that of contributing to the dissolution of putrid animal and vegetable matter.

Locusta. *Sp.* 1. *Locusta.* Inferior antennæ as long as the body; the last division with between thirty and forty smaller joints.

Cancer locusta of Pennant and Gmelin. *Oniscus locusta* of Pallas. *Gammarus locusta* of Fabricius? *Cancer gammarus saltator* of Montagu. *Talitrus locusta* of Latreille.

Inhabits the sandy shores of the European ocean. It has acquired the name *Locusta* from the form of its mouth, which is protruded, and very much resembles that part of a locust. Length three quarters of an inch. Colour, when alive, corneous; when dead, whitish, and often mottled with reddish. It has never been taken in the water; it burrows in the sand, and serves as food to the shore birds, who devour it with avidity.

Sp. 2. *Littoralis.* Inferior antennæ much shorter than the body, the last segment composed of about twenty-five joints. Littoralis.

Talitrus littoralis. Leach's MSS.

Inhabits all the sandy shores of Britain. It was first observed by the Rev. J. Fleming, who communicated it to Mr Leach, from whose manuscripts it is here inserted. Length about half an inch. Colour corneous, inclining to reddish on the back. It is so common, that a more minute account is unnecessary, it having all the habits of the preceding species.

Genus LIV. Orchestia. Two anterior pair furnished with a moveable thumb, which is capable of being bent on the edge of the hand; second pair largest, having a compressed hand. 54. Orchestia.

Sp. 1. *Littorea.* Hand ovate, the part which meets the thumb slightly toothed or wrinkled. Thigh of the posterior pair of legs jointed, and very much compressed. The female wants the hands. See Plate CCXXI. Fig. 6. Littorea. Plate CCXXI. Fig. 6.

Pulex marinus of Baxter; *Cancer gammarus littoreus* of Montagu; *Orchestes littorea*, Leach's MSS.; *Talitrus gammarellus*, Latreille?

This species is the only one of the genus hitherto discovered. It is very common on many of our shores, lurking under the rejectamenta of the sea, having all the habits of the preceding genus. Latreille quotes Baxter's figure, which renders it highly probable that this may be his *Talitrus gammarellus*; but as he quotes also the *Oniscus gammarellus* of Pallas, it still remains in some doubt.

2. Superior antennæ longer, or at least as long as the inferior. Fourteen feet, the third and fourth pair smallest.

Genus LV. Gammarus. The four anterior feet furnished with a moveable nail, which is capable of being bent inwards on the hand. Abdomen with thirteen joints. Peduncle of the antennæ with three joints. 55. Gammarus.

Observation. The animals composing this genus inhabit ponds and rivulets, also the sea side. The males are considerably larger than the females, which they embrace with their claws, often swimming about with them, and not unfrequently on their back. The females carry about their young with them after their exclusion.

* Fresh water.

Sp. 1. *Pulex.* Eyes ovate, situated on a level with the base of the superior antennæ; back near the tail with fasciculi of spines. Pulex.

Cancer pulex of Linné and Pennant; *Gammarus pulex* of Fabricius and Latreille.

This species is utterly incapable of living in the sea, although we have the authority of Linné and many of his followers to the contrary; the truth is, that Linné included the various species of this genus under the names *Cancer locusta* and *Pulex*; this shows the necessity and advantage of constituting natural genera, the only way by which we can ever hope to attain an accurate knowledge of species.

A species which Mr Leach considers as distinct from *pulex*, was discovered in water taken from a

Crustacea. newly sunk well, in the square of St Bartholomew's hospital, London, by Thomas Wheeler, Esq. apothecary to that institution, who sent it to Mr Leach, in whose collection it is now preserved. It is very probably a young animal; it differs principally from *Gammarus pulex*, in having the upper process of the tail much longer. The colour, when alive, was cinereous, but so translucent, that the eyes could not be discovered; it stands in Mr Leach's cabinet, under the specific name *subterraneus*, as it most probably inhabits springs under the earth.

** Marine.

Locusta. *Sp.* 2. *Locusta.* Eyes lunated and placed in a line with the superior antennæ; back near the tail with fasciculi of spines.

Cancer locusta of Linné. Is it *Cancer gammarus locusta* of Montagu? *Linn. Trans.* vol. ix.

Inhabits pools left by the tide, on all the rocky shores of Great Britain.

Length of the male an inch.

Camylops. *Sp.* 3. *Camylops.* Eyes shaped like the capital letter S, extending from the upper part of the superior to the upper part of the base of the inferior antennæ. Back near the tail with fasciculi of spines.

Discovered on the shore of Arran, by Mr Leach, who named it, from the flexuous shape of the eyes, *G. camylops.*

Length of the male half an inch, female somewhat less.

Mus. Leach

Rubricatus. *Sp.* 4. *Rubricatus.* Eyes angulated; situated between the superior and inferior antennæ.

Cancer gammarus rubricatus of Montagu. *Ampithöe rubricata*, Leach's MSS.

Length half an inch.

Inhabits Britain.

Discovered by George Montagu, Esq. and well described by him in the *Transactions of the Linnean Society*, vol. ix. Colour, when alive, usually reddish, or pale pink, minutely and closely speckled with spots of a darker shade. Eyes crimson. It is a rare species, and possibly does not belong to this genus.

56. Mæra. Genus LVI. Mæra. Anterior pair of feet with a moveable nail; the second pair with a compressed hand and moveable thumb. Peduncle of the antennæ with three joints; the superior antennæ longest.

Grossimana. *Sp.* 1. *Grossimana.* Body smooth, with eleven joints; superior antennæ nearly as long as the body. Internal edge of the palm of the second pair of feet ciliated, having a slight groove to receive the thumb.

Length five lines.

Colour, when alive, pale yellow, sometimes mottled with pink.

Cancer gammarus grossimanus of Montagu. *Mæra grossimana.* Leach's MSS.

Inhabits pools left by the receding tide, on all our rocky shores.

57. Melita. Genus LVII. Melita. Anterior pair of feet very small; second pair with a compressed hand, and moveable nail which bends on the palm. Superior styles of the tail very long and large.

Palmata. *Sp.* 1. *Palmata.* Blackish; the tail above, with a few spines.

Inhabits the rocky shores near Plymouth in Devonshire. Crustacea.

Gammarus palmata, Montagu, *Linnean Transactions*, vol. vii. tab. 6. *Melita palmata*, Leach's MSS.

Genus LVIII. Leucothöe. Anterior feet with a finger and thumb; the thumb jointed; second pair with a moveable thumb but no finger. Peduncle of the antennæ with two joints. Superior antennæ longest. 58. Leucothöe.

Sp. 1. *Articulosa.* Body smooth and glossy. Eyes garnet-coloured. Wrist of the second pair of feet with a projecting compressed lamella. Internal edge of the hand slightly toothed. Articulosa.

Cancer articulosus of Montagu.

Leucothöe articulosa. Leach's MSS.

Inhabits the bottom of the sea.

Length half an inch.

Mus. Montagu, Leach.

Obs. It is probable that *Phronima sedentaria* of Latreille, *Genera Crustaceorum et Insectorum*, vol. i. p. 56. plate 2. fig. 2. forms a distinct family; but as a specimen has never come under our inspection, we shall translate his words in this note.—" Feet ten; the third pair longest and furnished with compound hands.

" *Cancer sedentarius Forsk. F. Arab.* page 95."

He observes farther, that it inhabits the Mediterranean Sea, dwelling in a cell composed of a gelatinous matter, (perhaps the dead body of a beroe,) of a bladder-like appearance, open at both ends. It often changes its posture, but generally sits within its nest.

It has lately been discovered in Zetland amongst the rejectamenta of the sea, by the Rev. J. Fleming, one of our most zealous and enlightened naturalists.

Family XV. Corophini.

Genus LIX. Corophium. Body elongated, composed of ten joints. Tail three jointed, with four bifid styles. Feet fourteen, the anterior pair furnished with a moveable thumb. The upper antennæ armed with a seta, the under ones as long as the body, very thick, more resembling feet than antennæ. 59. Corophium.

Sp. 1. *Longicornes.* The under part of the second joint of the antennæ near the apex, armed with a sharp spine. Longicornes.

Cancer grossipes of Linné; *Oniscus volutator* of Pallas; *Gammarus longicornis* of Fabricius; *Astacus linearis* of Pennant; and *Corophium longicorne* of Latreille.

Inhabits the European Ocean.

Length half an inch.

Family XVI. Caprellini.*

Genus LX. Caprella. Body linear. Eyes situated behind the antennæ. Antennæ four jointed, the upper ones with the last segment as long as the three others, and composed of several minute articulations; the under ones somewhat compressed, half the length of the superior. The first pair of feet (*palpi* of Montagu) situated very near the mouth; the second pair with the hand denticulated on the inside. Fins of a membranaceous jelly-like substance of a globular form. The anus with two little appendices. 60. Caprella.

* The body of these animals, exclusive of the head, is composed of six joints, all except the second and third bearing feet. The second and third segments furnished on each side with two processes, which probably serve as fins. Feet ten, all armed with a moveable nail; the anterior pair very small, and originating from the head. Mouth with two jointed palpi, armed at the point with a little hook.

The female is furnished with a pouch; situated between the fins, in which she carries about the eggs and her young after their exclusion, until they are enabled to shift for themselves.

Crustacea.

Linearis.

Sp. 1. *Linearis.* Head with one little tubercle. Hand of the second pair of feet with three teeth on the inner edge.

Cancer linearis of Linné; *Astacus atomos* of Pennant; *Caprella linearis* of Latreille; *Oniseus scolopendrioides* of Pallas.

Inhabits the European Ocean, affixing itself to fuci and other marine plants. Colour, when alive, brown, inclining to cinereous, beautifully spotted with rust-colour.

Phasma.

Sp. 2. *Phasma.* The first joint of the body with two spines; a third spine on the anterior part of the second joint; a fourth spine on the head, all pointing forward. Hands of the second pair of feet with one strong spine. Colour generally pale olive green. Discovered on the coast of South Devon on *fuci*, by Mr Montagu, and described in vol. vii. of *Linnean Transactions*, by him.

Penantis.

Sp. 3. *Penantis.* Back without spines; anterior part of the head produced into a spine; hands of the second pair of feet with one tooth.

Astacus atomos of Pennant.

Common on the Devonshire coast.

Acanthifera.

Sp. 4. *Acanthifera.* Back, especially the hinder part, spiny; inner edge of the second hands lunate-excavated.

Caprella acanthifera, Leach's MSS.

Discovered in Devonshire, where it is not uncommon.

61. Panope.

Genus LXI. Panope. Body depressed. Eyes situated on the vertex of the head. Antennæ four jointed; the upper pair, with the basilar joint, largest; the second and third equal, but rather shorter than the first; apical joint very small; inferior pair also composed of four joints, shorter than the first joint of the upper pair. Feet compressed and armed with strong nails; the anterior pair situated on the base of the head, the wrist jointed. Hands of the second pair armed with teeth on their inner edge. Fins of a leathery-membranaceous substance, cylindrical and elongated. Anus produced, having a few obscure small tubercles on each side and under.

The pouch of the female with four valves.

Ceti.

Sp. 1. *Ceti.* Base of the fins with a process resembling the figure 6; the hands of the second pair of feet with two obtuse teeth on the thumb side of the hands. Anus with three processes.

Inhabits the European Ocean, attaching itself to whales, and, according to Latreille, to fishes of the genus Scomber.

Oniscus ceti of Linné; *Pycnogonum ceti* of Fabricius. *Panope ceti*, Leach's MSS.

Family XVII. Apseudii.

62. Apseudes.

Genus LXII. Apseudes. Body six jointed, tail with six segments, the last largest, armed at the apex with appendices. Feet fourteen, the *anterior pair* with a finger and thumb; the *second pair* compressed and dentated; the *third and fourth* alike and simple; the *fifth* with a double nail?; the *sixth and seventh* spurious. The superior antennæ with a biarticulated peduncle armed at the apex with a jointed seta; the inferior antennæ bifurcate.

Talpa.

Sp. 1. *Talpa.* Rostrum acute, with three excavated longitudinal grooves.

Cancer gammarus talpa of Montagu; *Apseudes talpa*, Leach's MSS.

Inhabits the British Ocean; length four lines; colour yellowish-white; is very rare.

Mus. Montagu, Leach.

ORDER III. MYRIAPODA.

Crustacea.

Family XVIII. Asellides.

I. The four antennæ very distinct.

Genus LXIII. Asellus. Tail composed of one piece, with two longitudinal foliaceous double-jointed lamellæ, and two bifid styles inserted about the middle of the posterior margin. Antennæ setaceous; the last segment composed of a great many smaller joints. 63. Asellus.

Sp. 1. *Vulgaris.* Colour cinereous, often spotted with grey or white. Vulgaris.

Inhabits ditches and wells very frequent, and is considered as a proof of the goodness and purity of the water.

Oniscus aquaticus of Linné and Donovan; *Idotea aquatica* of Fabricius; *Entomon hieroglyphicum* of Klein; *Asellus vulgaris* of Latreille.

Genus LXIV. Idotea. Tail with two or three segments, and two longitudinal plates as in the genus Asellus. The internal or middle antennæ composed of four joints, and placed somewhat above the exterior ones. 64. Idotea.

Genus Stenosoma of Leach.

* Body linear, external antennæ very long.

Sp. 1. *Hecticus.* The segments of the abdomen laterally dilated. Colour cinereous brown, or greenish-brown, sometimes bordered with grey or cinereous brown. Hecticus.

Inhabits the European Ocean.

Oniscus linearis of Pallas and Pennant; *Oniscus hecticus* of Gmelin. *Idotea tridentata* of Latreille is only a variety of this species.

** Body thickest in the middle. Idotea, Leach.

Sp. 2. *Entomon.* Body of an oblong oval; the segments swelling at the sides; tail conical and elongated, having a tooth on each side of the base. See Plate CCXXI. Fig. 7. Entomon. Plate CCXXI. Fig. 7.

Inhabits the European Ocean.

Oniscus entomon of Linné and Pennant; *Cymothoa entomon* of Fabricius; *Oniscus œstrum*, Donovan, in Rees' *Cyclopædia*, article Entomology, plate x.

It is very probable that *Oniscus marinus* of Pennant is merely a variety of this species; both are found on all our rocky coasts in the greatest plenty: it differs merely in having the tail more conical than in *entomon*, and having no teeth at the base; there are, however, so many intermediate varieties, that it cannot with propriety be considered as a distinct species.

Sp. 3. *Œstrum.* Segments of the abdomen slightly prominent at the sides. Tail deeply notched, with a very small protuberance in the middle of the notch. Œstrum.

Inhabits the European Ocean.

Oniscus œstrum of Pennant.

Genus LXV. Anthura. Body linear; tail with two broad moveable plates on each side, which, when the animal is alive, much resemble a five-petaled flower. Antennæ short, the interior or upper pair rather longest. Anterior pair of feet furnished with a moveable hook or thumb. 65. Anthura.

Sp. 1. *Gracilis.* Lateral appendices of the tail obliquely truncated. Colour pale, coloured with rufous. Gracilis.

Inhabits the British seas, but is very rare.

Oniscus gracilis, Montagu; *Anthura gracilis*, Leach's MSS.

Observation. *Oniscus cylindricus* of Montagu, *Linnean Transactions*, vol. vii. p. 71. plate 6. fig. 8, seems to belong to a genus nearly allied to *Anthura*; but as no specimen has ever occurred to us, we must content ourselves with transcribing the description given by that author.

" *Oniscus cylindricus*, with a smooth, glossy, cylindric, and very convex body, with seven joints independent of the head, tail, and five narrow segments at the base of the latter; central caudal fin subovate, with two smaller lateral ones on each side, which, when spread, give it a quinquedentate appearance: antennæ four, short, the upper pair not half so long as the other; legs fourteen; feet of the foremost six broad, serrated on the inside; all armed with a single claw.

"Length an inch; breadth not quite a quarter. Colour pale yellow, clouded with cinereous on the sides."

66. CYMOTHOA. GENUS LXVI. CYMOTHOA. Tail composed of a great many segments, the last at its base bearing a double appendage on each side. Most of the segments bearing feet, their lateral margins being thickened. Antennæ setaceous and many-jointed, inserted one pair above the other, under the clypeus. Feet with strong, sharp nails.

Asilus. *Sp.* 1. *Asilus.* Head with three protuberances or lobes on the hinder part: the hinder segments (the last excepted) arched backwards; the last segment semi-elliptical.

Inhabits the European ocean.

Oniscus asilus of Linné and Pallas; *Cymothoa asilus* of Fabricius and Latreille.

Œstrum. *Sp.* 2. *Œstrum.* Body oblong oval, the last segment transverse.

Inhabits the European Ocean.

Oniscus œstrum of Linné and Pallas; *Cymothoa œstrum* of Fabricius and Latreille.

Observation. It is highly probable that *Oniscus testudo* of Montagu (*Transactions of the Linnean Society of London*, vol. ix. page 102. tab. 5. fig. 5.) is referable to a genus akin to this; but as we have never had an opportunity of examining this species, we cannot speak with certainty on this head, but content ourselves by quoting the description given by that author.

"*Oniscus testudo.* Body subovate, composed of eight joints, rising to a ridge on the back; the plates elevated on their edges; the four first fall very low on the sides, and obscure the anterior legs; along each side of the body a row of small tubercles: the front sub-bifid: antennæ four, very short, the lower pair hid beneath: eyes prominent and black; posterior end obtusely pointed; caudal fins beneath, obscure; legs fourteen, short and strong, the three posterior pairs longest; all furnished with a simple claw.

"Length two lines.

"Colour dull red, with a white spot on the anterior part of the back, but as the animal dies this mark is lost. Rare."

67. SPHÆROMA. GENUS LXVII. SPHÆROMA. Tail composed of two segments; the last furnished with a double lateral foliaceous appendage, placed on a common footstalk on each side. Body oval, capable of rolling into a globular form, composed of seven joints. Antennæ setaceous and many jointed, inserted by pairs one above the other; their bases placed very close together; the upper pair with a very large peduncle.

Serrata. *Sp.* 1. *Serrata.* Body smooth; the anal segment of the tail rounded, the sides obliquely truncated; the lamellæ equal, elliptical, with their points sharp.

Oniscus globator of Pallas; *Cymothoa serrata* of Fabricius; *Sphæroma cinerea* of Latreille.

Inhabits the European Ocean; is very abundant on several of our rocky coasts in pools left by the tide; when touched, it contracts into a ball. Length nearly half an inch. Colour, when alive, cinereous, very beautifully speckled with black.

Rugicauda. *Sp.* 2. *Rugicauda.* Body smooth; the anal segment rough, rounded at the apex; the sides obliquely truncated; the lamellæ equal, their points somewhat rounded.

Sphæroma rugicauda, Leach's MSS.

Inhabits the Atlantic Ocean.

It was discovered on the shore of Ulva, one of the Western Isles of Scotland, by Mr Leach: he observed that it was more agile than *Sphæroma cinerea*, from which species it is readily distinguished by the roughness of the anal segment, and the smaller size of the peduncle of the superior antennæ. He has since observed it in very great plenty near the Ware-head, on the river Tamer, in Devon, where the water is but brackish; a curious contrast with the original habitat in the Atlantic!

Colour, when alive, cinereous, very beautifully speckled and streaked with black. Eyes black. Length about one-third of an inch.

GENUS LXVIII. NESÆA. Apex of the tail on each side with a single foliaceous appendage placed on a footstalk. Body oblong. Antennæ setaceous, and nearly of an equal length; the upper pair with a very large double-jointed peduncle, (the basilar joint largest,) which occupies nearly half their length. Space between the antennæ very visible. Body composed of six joints, the last largest. 68. NESÆA.

Sp. 1. *Bidentata.* Last segment of the body armed with two spines or teeth. Bidentata.

Oniscus bidentatu, Linnean Transactions.

Næsea bidentatas, Leach's MSS.

Inhabits the British ocean: the living specimens we have seen were cinereous, faintly streaked with red.

GENUS LXIX. CAMPECOPEA. Base of the tail armed with a bent foliaceous process on each side. Body composed of six joints. Antennæ setaceous, the upper pair longest, with the peduncle composed of two visible joints; the intermediate space between the superior antennæ very great. 69. CAMPECOPEA.

Sp. 1. *Hirsuta.* Body hirsute. Hirsuta.

Oniscus hirsutus, Montagu, *Lin. Trans.* vol. vii. t. 6. f. 8. *Campecopea hirsuta*, Leach's MSS.

Colour (according to Montagu) brown, with sometimes a few faint bluish spots on the posterior joint. Length one-eighth of an inch.

Inhabits the European ocean, but is rather rare.

II. The antennæ obscure, or entirely wanting.

GENUS LXX. BOPYRUS. Body depressed, of an incurvate oval form. The under part on each side with four foliaceous marginal appendices. Feet minute, spurious, bent, and placed on the margin. The last segment of the tail small. 70. BOPYRUS.

Sp. 1. *Squillarum.* Colour pale greenish. Squillarum.

Monoculus crangorum of Fabricius. *Bopyre des crustacés* of Bosc. *Oniscus squillarum* of Montagu. *Bopyrus squillarum* of Latreille.

Inhabits the European ocean, dwelling under the thoracic plate of the prawn (*Palæmon squilla*) or shrimp (*Crangon vulgaris*), and causing a tumour on the sides of the animal. It varies much in shape, taking the form of the shell. It is so common, that it is surprizing it should have escaped the notice of all British naturalists until it was described in the ninth volume of the *Linnean Transactions*, by George Montagu, Esq. It was first described in the *Memoirs of the Academy of Sciences*, in the year 1772, page 29, pl. 1.

Observation. Mr Montagu has described an animal as inhabiting the thoracic plate of CALLIANASSA *subterranea*; and as we have never seen the species, we

Crustacea.

must content ourselves by extracting the description given by that celebrated zoologist.

" *Oniscus thoracicus.* Body oval, inequilateral, with about fifteen indistinct joints, indented at the sides, the six posterior shooting into long, lateral, fasciculate, fleshy, ramose appendages, and the extremity furnished with six simple recurved ones, two of which are larger than the rest. Antennæ four, short; the outer pair longest, and only visible above. The two first joints of the body furnished with a long, flat, oar-like, fleshy fin, or cirrus, on each side; the other joints with similar short ones. Legs fourteen, very short, crooked, and concealed beneath. The abdominal valves are large, cover the whole under part of the body, and form a receptacle for the ova, which are, in specimens before me, vastly distended with many thousands of a pale orange colour.

" Length, including the posterior appendages, scarcely half an inch.

" Colour usually orange; lateral appendices whitish.

" The male is very inferior in size, of a more slender form, and is destitute of the cirri on the anterior part of the body, and those on the posterior joints are simple, not branched, as in the female; in other respects they agree."

Mr Montagu says likewise that he has extracted it from under the thoracic plate, and kept it alive in a glass of sea-water for several days. In the few which he has met with, the male was always found attaching itself to the ventral appendices of the female by its claws. That it forms a distinct genus from any here defined, and is referable to another division of the tribe, need scarcely be mentioned to the scientific reader.

Family XIX. Oniscides.

71. Ligia.

Genus LXXI. Ligia. The outermost segment of the external antennæ composed of a number of small articulations. A bifid style, placed on a peduncle on each side of the tail.

Observation. It has been supposed by Latreille, and other authors of eminence, that the number of joints in the last section of the external antennæ afforded specific distinctions in this genus; the observations, however, which we have made on *L. oceanica* and *scopulorum*, fully prove the evanescence of this character, as the joints not only vary in number in the same species, but even in the same individual.

Oceanica. Plate CCXXI. Fig. 8.

Sp. 1. *Oceanica.* Body brownish; back very rough; sides often beautifully speckled with minute black spots. See Plate CCXXI. Fig. 8.

Oniscus oceanicus, Linné. *Ligia oceanica* of Fabricius and Latreille.

Length half an inch.

Inhabits the shores of the European ocean.

This, and probably all the species, are very prolific: Mr Williams, an ardent student of zoology, found above seventy young ones in the abdominal pouch of a female, in the month of August.

Scopulorum.

Sp. 2. *Scopulorum.* Body cinereous, sides speckled with minute black spots; back somewhat rough.

Ligia oceanica, variety, Leach's MSS.

This species, which is probably a variety of the preceding, is very common on the rocky coasts of Devonshire. It is nearly three times the size of *L. oceanica,* from which it is readily distinguished by the comparative smoothness of its back, and superior size.

Observation. The above species are all that we have met with. Three others are enumerated by Latreille; these we shall mention in his words.

" 3. *Italica.* Antennæ almost as long as the body; the last joint composed of seventeen minute articulations; styles of the tail equal, exserted; the footstalks narrow and elongated." Italica.

Ligia Italica of Fabricius.

4. " *Hypnorum.* Antennæ half the length of the body; the last joint composed of ten minute articulations; the caudal styles exserted, with the point of the peduncle internally produced into a setigerous tooth; the body above variegated with cinereous and yellow." Hypnorum.

Oniscus hypnorum of Cuvier and Fabricius.

Oniscus agilis of Panzer.

Latreille observes, " It inhabits the shores of the British Ocean; I received it from the celebrated Brébisson."

" 5. *Oniscoides.* Styles of the tail very short, not exserted; the laciniæ ovate-lanceolate." Oniscoides.

Oniscus assimilis of Linné. *Cymothoa assimilis* of Fabricius.

" Inhabits the Mediterranean Sea."

Genus LXXII. Philoscia. External antennæ eight-jointed, the base naked. The first segments of the tail abruptly narrower than the preceding joints of the body. 72. Philoscia.

Sp. 1. *Muscorum.* Body variegated with cinereous and white. Muscorum.

Oniscus muscorum of Scopoli and Cuvier. *Oniscus sylvestris* of Fabricius. *Philoscia muscorum* of Latreille.

Is found under mosses and stones in England, France, and Germany.

Genus LXXIII. Oniscus. The external antennæ with eight joints, inserted under the margin of the anterior part of the head. 73. Oniscus.

Sp. 1. *Asellus.* Body above obscurely cinereous and rough, with white longitudinal lines of spots; the sides yellowish. Asellus.

Oniscus asellus of Linné and Latreille. *Oniscus murarius* of Fabricius and Cuvier.

Inhabits rotten wood, old walls, &c. throughout Europe.

It was formerly used in medicine, being supposed to cure agues, consumptions, &c. but is now wisely rejected from the modern pharmacopœias. Its vulgar names are *common millepied* or *sows.*

Genus LXXIV. Porcellio. External antennæ seven jointed, inserted under the margin of the anterior part of the head. The lateral styles of the tail conic and prominent. 74. Porcellio.

Sp. 1. *Scaber.* Body above rough and granulated. Scaber.

Oniscus asellus of Cuvier, Fabricius, and Panzer; *Porcellio scaber* of Latreille.

Inhabits Europe.

This species is found under stones, in rotten wood, and on old walls. It varies much in colour, being at one time bluish black, at another time yellow. In Scotland it is called *sclater.*

Sp. 2. *Lævis.* Body smooth. Lævis.

Porcellio lævis of Latreille.

Inhabits the same place as the former species. In this country it is rare, one specimen only having been taken by Mr W. E. Leach, in Devon.

Obs. To this genus, *Oniscus convexus* of De Geer (*Mem. sur les Insect,* tom. vii. pl. 35. fig. 11.) appears to belong.

Genus LXXV. Armadillo. External antennæ seven jointed, the lateral styles of the tail not prominent, the last joint triangular, and meeting the hinder margin of the posterior margin. Body capable of rolling into a ball. 75. Armadillo.

Sp. 1. *Vulgaris.* Body above of a greyish-lead colour; the posterior margins of the segments white. Vulgaris.

Crustacea.

Oniscus armadillo of Linné and Cuvier; *Armadillo vulgaris* of Latreille.

Inhabits the roots of trees and rocks all over Europe.

Oniscus cinereus of Panzer is merely a variety of this species.

Its vulgar name is *Pill millepied.*

Variegatus. *Sp.* 2. *Variegatus.* Segments black, margined with white; back variegated.

Oniscus variegatus of Villers, *Armadillo variegatus* of Latreille.

Oniscus pulchellus of Panzer, (*Fn. Ins. Germ.* fasc. 62. fig. 21.) seems near akin to this species.

FAMILY XX. JULIDES.

76. GLOMERIS. GENUS LXXVI. GLOMERIS. Antennæ inserted on the upper anterior margin of the head; the two basilar joints small; the sixth, including the last, very large. Body oblong-oval, convex above, arched beneath, capable of contracting into a ball; the first segment very narrow, being merely a semicircular lamella; the second larger than any of the others; the last semicircular.

* *Feet on each side sixteen.*

Marginata. *Sp.* 1. *Marginata.* Body black above, the margins of the segments of a dirty orange yellow.

Inhabits Britain, France, and Germany, under stones.

Oniscus marginatus of Villers, *Oniscus zonatus* of Panzer, *Cloporte bordé* of Olivier, *Glomeris limbata* of Latreille, *Julus oniscoides* of Stewart.

Pustulata. *Sp.* 2. *Pustulata.* Body black above, spotted with red.

Inhabits the southern parts of France and Germany.

Oniscus pustulatus of Fabricius; *Oniscus armadillo* of Scopoli.

** *Feet on each side twenty.*

CRYXUS, Leach's MSS.

Ovalis. *Sp.* 3. *Ovalis.* Body dirty yellow.

Inhabits the ocean.

Julus ovalis of Linné, *Julus ovatus* of Fabricius, *Glomeris ovalis* of Latreille, CRYXUS *ovatus*, Leach's MSS.

It is surprising that Latreille should have placed this species in the genus GLOMERIS: though we had never seen the animal, the description and figures would almost have justified us for entertaining this opinion; its economy, the number of legs, at once exclude it altogether from this genus; which, in Mr Leach's manuscripts, as above quoted, is considered as a distinct genus.

77. JULUS. Plate CCXXI. Fig. 9. GENUS LXXVII. JULUS. Antennæ inserted in the anterior margin of the head; the second joint longer; the sixth, including the seventh, (which is very minute), shorter than that which precedes it. Body cylindrical, elongate, serpentiform, the segments rarely marginated. Eyes distinct and granulated. (The second and third segments of the body often bearing but one pair of feet.) See Plate CCXXI. Fig. 9.

* Body not marginated or laterally depressed.

Terrestris. *Sp.* 1. *Terrestris.* Feet 64 to 74 pairs; back cinereous, with light brown annuli; the last segment pointed. *Latr. Gen. Crust. et Ins.* tom. i. p. 75.

Inhabits Europe.

Julus terrestris of Latreille, who describes it as having 64 or 74 pair of legs; Linné, Fabricius, and Degeer, mention 100 pair of legs as proper to this species. We have never seen this animal, therefore can give no opinion on this point; although it is probable, from the above remark, that two species have been confounded; future observation must however decide this point.

Niger. *Sp.* 2. *Niger.* Body black, legs pale, from 88 to 95 in number, (or perhaps more); the hinder part of the segment longitudinally streaked; anus pointed.

Inhabits Britain, under the bark of decaying trees, or under stones and moss.

Julus niger, Leach's MSS.

This species, when alive, is black, although it sometimes, though rarely, occurs of a brownish black colour. After death it generally changes to blue, having the margins of the segments brown or yellowish, with a row of black spots along the sides of the body. It is by far the most common species in the neighbourhood of Edinburgh.

Sabulosus. *Sp.* 3. *Sabulosus.* Back greyish-black, with two longitudinal reddish lines; the last segment pointed. Feet 95 pair.

Inhabits Europe; is common in this country under stones, and on the bark of trees.

Julus sabulosus of Linné, Fabricius, and Latreille.

Maximus. *Sp.* 4. *Maximus.* Feet on each side one hundred and thirty-four.

Inhabits America.

Julus maximus of Linné and Fabricius.

Fuscus. *Sp.* 5. *Fuscus.* Feet on each side one hundred and twenty-four; back brownish.

Inhabits India.

Julus fuscus of Linné and Fabricius.

Indus. *Sp.* 6. *Indus.* Feet on each side one hundred and fifteen; body rust coloured, the last segment pointed; feet yellowish.

Inhabits India.

Julus Indus of Linné and Fabricius.

Obs. There are several species, or varieties of Juli, belonging to this subdivision, which inhabit this country, but the marks by which they are distinguished are not sufficiently known to enable us to give an account of them. Much remains to be done in this department, and it would prove highly beneficial to science, were naturalists to breed, from the young state, the various species of these JULI, and mark the changes produced in the animal during its growth, as colour, formation of new feet, &c. Until this has been done, nothing can be added to this genus without great uncertainty.

** Body more or less marginated, or laterally compressed. Genus CRASPEDOSOMA of Leach.

Raulinsii. *Sp.* 7. *Raulinsii.* Body blackish; back with two light red longitudinal lines; head black; feet and belly reddish-white; side somewhat marginated, or rather compressed; back with one longitudinal sulcus.

Inhabits Scotland, under stones and in decaying trees.

Craspedosoma Raulinsii. Leach's MSS.

Discovered by a very assiduous entomologist, Richard Rawlins, Esq.* under stones near Edinburgh, where it appears to be pretty common; it has since been observed under the bark of decaying willow trees and moss, near Roslin and in Ravelston wood.

Polydesmoides. *Sp.* 8. *Polydesmoides.* Body considerably depressed;

* We have now most sincerely to lament the premature death of this gentleman, who, had he survived, would have proved one of the greatest ornaments in the department of Zoology including the animals without vertebræ that has ever appeared in this country. His industry and acquirements were truly astonishing, and his zealous ardour remained to his last moments.

Crustacea. the segments laterally produced, bearing little spines; back with one longitudinal groove; each segment with two slight tubercles on the sides of the groove.

Julus polydesmoides, Montagu's MSS.

Inhabits Devonshire, often occurring under stones.

78 Polydesmus. Genus LXXVIII. Polydesmus. Antennæ inserted on the superior margin of the head, the last joint exserted: body linear; the segments laterally compressed and marginated; eyes obsolete. *The seventh segment from the head bearing but one pair of feet in the male.* The anterior joints of the body, in both sexes, generally having but one pair of feet.

Complanatus. *Sp.* 1. *Complanatus.* Back tuberculated; body depressed; the last joint pointed; feet and belly light yellowish white; upper part light reddish-brown.

Julus complanatus of Linné and Fabricius; *Jule aplatie* of De Geer, *Polydesmus complanatus* of Latreille.

Inhabits moist woods and hedges under moss and stones; is very frequent about Edinburgh and London.

79. Pollyxenus. Genus LXXIX. Pollyxenus. Antennæ inserted under the margin of the head, very short and cylindrical. Body elongated and depressed, the last segment armed with a pencil.

Lagurus. *Sp.* 1. *Lagurus.* Body brownish.

Scolopendra lagura of Linné and Fabricius, *Pollyxenus lagurus* of Latreille.

Inhabits Europe. Not yet observed in Britain.

Family XXI. Scolopendrides.

I. Every segment of the body bearing two pair of feet.

80. Scutegera. Genus LXXX. Scutegera. Each joint bearing two pair of feet.

Coleoptrata. *Sp.* 1. *Coleoptrata.* Feet thirty; body reddish-yellow, with longitudinal lines, and bands on the feet of a blue-black colour.

Genus Cermatia of Illiger.

Julus araneöides of Pallas, *Scutigera araneöides* of Latreille.

Inhabits houses in the southern parts of Europe; In Mr Leach's museum are specimens of a very large size from Madeira.

II. Every segment of the body bearing one pair of feet.

The insects composing this division, have been considered, by all authors who have illustrated this department with their writings, as forming one genus, which they named Scolopendra. The specific characters were taken from the number of feet: thus all the species having forty-two feet, were considered as one species, under the name Scolopendra *morsitans*; and other species (as we shall point out below) were confounded with one another in the same manner. In the following arrangements, we shall adopt genera divided from Scolopendra by Mr W. E. Leach, which we have copied from his manuscripts.

81. Scolopendra. Plate CCXXI. Fig. 10. Genus LXXXI. Scolopendra. Antennæ conico-setaceous, composed of many articulations, which are nearly conical. The inferior lip somewhat narrower before than behind; the anterior margin denticulated, and divided by a deep fissure. Feet forty-two in number, the hinder pair spinous at their base. The segments of the body somewhat marginated. The anterior pair of feet minute. Eyes eight in number, four on each side placed in a rhomboidal form. See Plate CCXXI. Fig. 10.

Obs. All the species of this genus have been considered as one by all authors, their characters being "Pedibus utrinque 20, oculis octo," *Linn. Syst. Nat.* 1068. *Fab. Ent. Syst.* 2—390. In this character the last feet are not enumerated. In the works of De Geer and Latreille, we find the last pair (which are much larger than the rest, but organised in the same manner) computed as feet, and the character "posterioribus spinosis," particularly noted in the specific character: this last, as we have mentioned in the generic character, is common to all the species, as is also the Linnean "eyes eight." We shall now point one such species as have come under our notice; and we have no doubt that many more remain to be discovered, which hitherto have been confounded under the title of *S. morsitans.*

* The segments transversely quadrate.

Sp. 1. *Spinipes.* The segments rusty-brown; the angles rounded; the antennæ, palpi, galeæ, posterior margins of the segments, and feet, yellowish; all the feet (excepting the anterior pair) with small spines on their joints. Spinipes.

Scolopendra Spinipes. Leach's MSS.

Habitat unknown.

Described from a specimen preserved in the College Museum of Edinburgh. Length about 11 inches. The lip and base of the mandibulæ ferrugineous. The whole body, when examined with a lens, punctulated. The nails, heels, and apex of mandibulæ, pitchy black.

Sp. 2. *Inermis.* Segments brown, with the posterior margins and feet pale; feet not spiny; hinder feet, as in the generic character, spiny at their base. Inermis.

Mus. Dr Barclay.

Scolopendra inermis. Leach's MSS.

Habitat unknown.

** Segments oblong-square.

Sp. 3. *Morsitans.* Joints rust-brown coloured; feet pale. Morsitans.

Habitat unknown.

Mus. Dr Barclay.

Scolopendra morsitans. Leach's MSS.

*** Segments alternately oblong and transversely quadrate.

Sp. 4. *Inæqualis.* Segments rusty-brown; feet pale. Inæqualis.

Habitat unknown.

Scolopendra inæqualis. Leach's MSS.

Genus LXXXII. Cryptops. Antennæ conico-setaceous, with 17 globular sub-conical joints. Anterior margin of the lip not denticulated, and scarcely notched. The basilar joint of the posterior feet not spiny; legs forty-two; eyes not discernible. 82. Cryptops.

Sp. 1. *Hortensis.* Body testaceous, inclining to rusty-brown; the back darker in colour; antennæ and feet hairy. Hortensis.

Cryptops hortensis. Leach's MSS. *Scolopendra hortensis*, Donovan's *British Insects*, vol. xv. where it was first figured and described, from specimens sent by Mr Leach, under that name, to Mr Donovan.

Inhabits gardens in and near Exeter in Devonshire, discovered by Mr Leach.

Genus LXXXIII. Lithobius. Antennæ with many joints, (about 45) the two basilar ones largest, of a conical-filiform shape each, joints nearly conical. Eyes granulated. Inferior lip anteriorly notched, the margin much denticulated. Feet thirty. 83. Lithobius.

To this genus Scolopendra *coleoptrata* of Panzer is referable. Leach's MSS. translated.

Sp. 1. *Forficatus.* The whole under lip deeply punctulated, the dots impressed; feet testaceous-yellow. Forficatus.

Scolopendra forficata of Linné, Fabricius, and Latreille; Lithobius *forficatus* of Leach's MSS.

Crustacea.

Inhabits Europe; is not very uncommon in many parts of England and Ireland, but has not yet occurred in Scotland or Wales.

Variegatus. *Sp.* 2. *Variegatus.* The whole under lip slightly punctulated with impressed dots; feet pale-testaceous-yellow, spotted with blackish-brown, or fuscous.

LITHOBIUS *variegatus.* Leach's MSS.

Discovered in Devonshire by Mr Leach, who was rather doubtful whether it is more than a variety of LITHOBIUS *forficatus*, but is now confident of its being distinct.

Lævilabrum. *Sp.* 3. *Lævilabrum.* Under lip very smooth, with lightly impressed obscure dots on the anterior part; feet testaceous yellow.

LITHOBIUS *lævilabrum*, Leach's MSS.

Common in Scotland in rocky places, living under stones, in fissures of rocks, and under moss.

84. Geophilus. GENUS LXXXIV. GEOPHILUS. Antennæ filiform, composed of fourteen nearly equal joints.

Electricus. *Sp.* 1. *Electricus.* Body linear and yellowish; feet about 140, (144 Latreille.)

SCOLOPENDRA *electrica*, Linné, Fabricius, Latreille; GEOPHILUS *electricus*, Leach's MSS.

Inhabits Europe.

This curious animal is found on decayed trees: it emits a dim phosphoric light as it moves along, often leaving behind it a shining track.

Observation. Besides the species of this family which have been here described, are many more inhabiting this country, but their natural history is so imperfectly understood, that we cannot at this time venture a description, lest we fall into error; much remains to be done, but should any species be accurately defined, we shall insert it under its proper head, together with all new discoveries in this and other classes, in the article ZOOLOGY.

Directions for preserving Crustacea for Cabinets.

Those species which inhabit the sea, should be suffered to remain for some hours in cold fresh water to extract the salt, which would soon destroy them by attracting moisture; they are then to be placed in a crawling posture, and the parts of the mouth are to be displayed by means of pins, until dry: they will then remain in that position. The more minute species must be dried, and afterwards stuck on paper with gum water, in different positions. Those of the last order, *Miriapoda*, are to be killed by immersion in spirits, and afterwards stuck with a pin on the right side. CRUSTACEA are kept in a cabinet lined with cork, to which they are affixed by pins; or in boxes loose: the former method is best, as they can then be moved from one place to another without trouble or risk. For a more particular account, we must refer to the article ENTOMOLOGY, where cabinets, modes of preparation, &c. will be found accurately detailed at full length.

CLASS II. ARACHNIDES.

Arachnides.

FROM ἀραχνη, a *spider*, and εἰδος, *resemblance*; a class of animals proposed as a distinct class by the celebrated Lamarck, Professor of Zoology in Paris, and established as such by Latreille and other eminent naturalists. As we mentioned in our introduction to this article, the animals composing this class were placed among Insects (INSECTA) by Linné, Fabricius, De Geer, and others; and in this light they were viewed by Latreille in his work on the genera of insects and crustacea; and he seems to have admitted them as a distinct class in his last work, rather through the persuasion of others than from his own judgment.*

In considering the classes CRUSTACEA and ARACHNIDES, we have, at the suggestion of Mr Leach, adopted an arrangement proposed by him, which contains some essential alterations, which, however, seem sufficiently warranted, as they tend to the ease of the student, and so far may prove much to the advancement of the science. By his arrangements, (which we have fully stated in our general remarks in the introduction to this article,) all those animals formerly considered as insects, without wings and antennæ, are placed in the class ARACHNIDES; consequently, the orders, 1. *Tetracera*, 2. *Myriapoda*, 3. *Thysanoura*, and 4. *Parasita* of Latreille, are rejected from this class: The two first are placed with the CRUSTACEA, and are considered as one order, to which the name *Myriapoda* is applied; the two latter he arranges with Insects, and places them in an order called by Linné *Aptera*. Of this we shall have occasion to speak more fully when considering the class INSECTA, under the article ENTOMOLOGY, and again comparatively in the article ZOOLOGY; it will therefore be unnecessary to take up the time of the reader, by saying any more on the subject at present; we shall therefore proceed to give the characters of the class ARACHNIDES, with those of its Tribes, Families, and Genera, after which the individual Species, with their structure and economy.

Anatomical Character.

No vertebræ; heart single; tracheæ † for respiration; feet for moving the body.

External Character.

Feet jointed, eight (rarely six) in number. Stigmata, or external openings of the tracheæ, visible. Body without wings. No metamorphosis, or scarcely any. No antennæ.

ORDER I. PODOSOMA.

BODY composed of segments, each segment being a continuation of the feet (at least apparently so.) HEAD distinct. THORAX not distinct from the body. FEET eight in number, each segment bearing one on each side.

TRIBE I. GNATHONIA.

Eyes four in number, placed on a tubercle on the anterior part of the body. *Ovifera* one on each side. *Mandibules.*

* See the Introduction to his *Considerations générales sur l'Ordre naturel des Crustaces, des Arachnides, et des Insectes.*

† Visible from the external openings.

Family I. Nymphonides.

Palpi two in number.

Genus I. Nymphon. Mandibules armed with a forceps.

Family II. Phoxichilides.

No palpi.

Genus II. Phoxichilus. Mandibules terminated by a simple bent nail.

TRIBE II. AGNATHONIA.

Eyes two in number. *Ovifera* none? *Mandibules* none.

Family III. Pycnogonumides.

No mandibules. No ovifera?

Genus III. Pycnogonum. Mouth furnished with a simple tube.

ORDER II. ELEUTEROSOMA.

Head connected with the thorax, which is generally distinct from the abdomen. Thorax feet bearing. Feet six or eight in number.

TRIBE I. HEXAPODA.*

Feet six in number.

Family IV. Astomides.

Feet six in number.

A. *Palpi and rostrum very conspicuous.*

Genus IV. Caris. Body consisting of one coriaceous piece, which is much depressed, and nearly orbicular.

Genus V. Leptus. Body soft and oval.

B. *Palpi and rostrum obscure.*

Genus VI. Astoma. Feet very short.

TRIBE II. OCTOPODA.

Feet eight in number.

A. *Abdomen* sessile, without any appearance of rings; *Mouth* generally produced into a rostrum or haustellum.

Family V. Hydrachnides.

Feet formed for swimming.

Genus. VII. Limnochares. Rostrum scarcely projecting.

Palpi without appendages.

Body depressed.

Mandibules none.

Genus VIII. Hydrachna. Mandibules none.

Rostrum conic, projecting, the points sharp.

Palpi projecting, the apex with a moveable appendage.

Genus IX. Elais. Mandibules depressed, the points armed with a nail.

Family VI. Ricinides.

Feet not formed for swimming; no mandibules; rostrum shaped like a bird's beak, or hunter's horn.

I. Eyes distinct. Body very soft and thick; the dorsal Skin not coriaceous.

* *Palpi obscure, not projecting.*

Genus X. Sarcoptes.

** Palpi more or less distinct.

Genus XI. Bdella. Palpi slender, filiform, long, and elbowed, the extremity armed with hairs.

Eyes four.

Posterior feet very long.

Genus XII. Smaris. Palpi slender, straight, and filiform, a little longer than the rostrum, without any setæ at the extremity.

Eyes two.

Anterior feet very long.

Genus XIII. Cheyletus. Palpi very thick, resembling arms.

II. Eyes indistinct: Body with a covering, partly membranaceous, partly coriaceous.

* *Palpi and rostrum obscure.*

Genus XIV. Uropoda. Feet very short; anus with a filament, by which it attaches itself to insects.

** *Palpi and rostrum distinct.*

Genus XV. Argas. Palpi short, conic, and free, not covering the rostrum.

Genus XVI. Ixodes. Palpi short and depressed, embracing the rostrum, and sheathing it.

Family VII. Acarides.

Feet not formed for swimming; with mandibules.

I. Palpi very short, and not projecting.

Genus XVII. Acarus. Body very soft. Mouth naked.

Genus XVIII. Oribita. Body covered wirh one coriaceous plate. The rostrum covering the parts of the mouth.

II. Palpi projecting.

* *No hook or moveable appendage at the extremity of the palpi.*

Genus XIX. Gamasus.

** *An hook or moveable appendage at the apex of the palpi.*

Genus XX. Erythræus. Body not divided. Eyes sessile.

Genus XXI. Trombidium. Body divided into two parts; the anterior division bearing the eyes, the mouth, and two first pairs of feet.

Eyes pedunculated.

B. Abdomen fixed or sessile, sometimes ringed. Mouth not prolonged into an haustellum or rostrum.

Family VIII. Phalangides.

Mandibules armed at their points with forceps; abdomen generally sessile; anus without tubercles of nipples.

I. Eyes not placed on a peduncle or tubercle.

Genus XXII. Siro. Mouth naked: Mandibules very long.

Genus XXIII. Trogulus. Mouth situated in a cavity, under the anterior part of the thorax; mandibules short.

II. Eyes placed on a common tubercle.

Genus XXIV. Phalangium. Eyes two. Palpi terminated by a hook. Body orbicular.

Genus XXV. Galeodes. Eyes four; palpi with no hook; body elongated.

* In the Appendix we have added two other genera to this tribe, viz. Nycteridia, which Latreille places with the Insecta, and a new genus, named by Dr Leach Ocypete.

Family IX. Araneides.

Mandibles terminated by a simple hook or nail; abdomen connected closely with the thorax; anus with nipples.

I. Feet not formed for leaping.

1. Hinder eyes not placed on the anterior and superior part of the thorax; not forming an irregular hexagon.

A. The two exterior nipples longer than the rest, cylindrical, and projecting. Lip not advanced between the maxillæ, nor prominent, but much longer than broad.

a. Mandibules projecting.

Genus XXVI. Mygale. Palpi inserted on the extremities of the maxillæ.

Genus XXVII. Atypus. Palpi inserted towards the base of the maxillæ. Lip quadrate, not prominent.

Genus XXVIII. Eriodon. Palpi inserted towards the base of the maxillæ; lip prominent, long, and narrow.

b. Mandibules perpendicular.

* *Six eyes.*

Genus XXIX. Segestria. Eyes disposed in a transverse line, crooked behind, at each extremity.

Genus XXX. Dysdera. Eyes disposed in nearly an oval form, open in front.

** Eight eyes.

Genus XXXI. Filistata. Maxillæ much inclined towards the lip; with no sinus or groove at the insertion of the palpi, they being inserted at the hinder side. Lip much longer than broad. The fourth, then the first pair of feet, longest. Eyes placed on an uneven elevation; the four anterior ones forming a semicircle open in front; the four hinder ones disposed in a nearly straight and transverse line.

Genus XXXII. Drassus. Maxillæ much inclined towards the lip, with no groove at the insertion of the palpi. Lip longer than broad. The fourth pair of feet, and then the first, longest. Eyes not placed on an elevation, disposed in two slightly curved (nearly straight) lines; those of the hinder line not geminated.

Genus XXXIII. Clotho. Maxillæ much inclined towards the lip, without a groove at the insertion of the palpi. Lip not much longer than broad. The fourth pair of feet, then the second, afterwards the third, longest. Eyes close, disposed in four and four, in two transverse lines, bent slightly backwards in an arched and somewhat concentric manner; those of the hinder line disposed in pairs, (geminated.)

Genus XXXIV. Clubiona. Maxillæ nearly straight, with a groove at the insertion of the palpi, the apex rounded, and obliquely truncated on the inside; evidently longer than the lip. Eyes disposed four and four in two transverse lines; the anterior line straight, the posterior much longer, bent slightly backwards.

Genus XXXV. Aranea. Maxillæ nearly straight, with a groove at the insertion of the palpi. Apex rounded, the internal angle truncated, remarkably longer than the lip. Lip nearly equal. Eyes disposed in two lines, bent backwards.

Genus XXXVI. Argyroneta. Maxillæ nearly straight, with a groove at the insertion of the palpi. Lip shorter than the maxillæ. The four middle eyes disposed in a quadrate form, the lateral ones geminated.

B. All the nipples short, and nearly equal, of a conic form. Lip projecting between the maxillæ, being much broader than long.

a. Eyes not describing the segment of a circle.

* *Maxillæ straightened towards their extremities, not dilated.*

Genus XXXVII. Scytodes. The first and the fourth pair of feet longest. Eyes six.

Genus XXXVIII. Theridion. The first and the fourth pair of feet longest. Eyes eight; the four middle ones arranged in a quadrangle, the inferior ones being placed in a common elevation; the other two geminated, and placed on an eminence on each side.

Genus XXXIX. Latrodectus. The first, and then the second pair of feet longest. Eyes eight, disposed four and four in two transverse and parallel straight lines.

Genus XL. Pholcus. The first, and then the second pair of feet longest. Eyes eight; placed on a tubercle; three on each side in a triangle, and two in the middle; anteriorly.

* *Maxillæ dilated at their points, and straight.*

Genus XLI. Uloborus. The first, and then the fourth pair of feet longest. Eyes eight, equal, very minute, placed at nearly equal distances from one another, on two transverse lines. The two middle ones a little nearer than the others; the anterior line bent backwards, the posterior bent forwards.

Genus XLII. Tetragnatha. The first, and then the second pair of feet longest. Eyes eight, and equal, disposed four and four in two straight transverse parallel lines.

Genus XLIII. Linyphia. The first, and then the second pair of feet longest. Eyes eight, the four middle ones forming a square, which is narrow in front, the other four geminated, and placed two on each side.

Genus XLIV. Epeira. The anterior, and then the second pair of feet longest. The four middle eyes forming an equal-sided square; the other four placed in pairs, two on each side.

b. The eyes describing the segment of a circle.

Genus XLV. Episenus. Maxillæ straight; lip much broader than long; the first, and then the fourth pair of feet longest.

Genus XLVI. Micrommata. Maxillæ straight; lip much broader than long; the second feet, and then the first pair longest.

Genus XLVII. Thomisus. Maxillæ inclined; lip much longer than broad; the second and the first pair of feet longer than the rest.

2. Hinder eyes placed on the anterior and superior part of the thorax, forming an irregular hexagon.

A. *The anterior feet longest, next to these the second.*

Genus XLVIII. Oxyopes. Maxillæ straight, and remarkably longer than the lip; eyes in four transverse lines.

Genus XLIX. Storena. Maxillæ inclined, much longer than the lip; eyes in three transverse lines.

Genus L. Ctenus. Maxillæ straight, and remarkably longer than the lip; eyes disposed in three transverse lines.

B. The fourth pair of feet longest.

Genus LI. Lycosa. Lip much longer than broad; the fourth feet and then the first longest.

Genus LII. Dolomedes. Lip not much longer than broad; the fourth pair, and then the second pair, of feet longest.

II. Feet formed for leaping.

Genus LIII. Eresus. The four middle eyes forming a quadrangle; on the outside of which the others are placed, as if forming another quadrangle to inclose them.

Arachnides.

GENUS LIV. SALTICUS. Eyes forming a horse-shoe or parabole open behind.

FAMILY X. TARANTULIDES.

Palpi very spiny, resembling arms; mandibules terminated by a simple hook; the two anterior feet very long, and antennæform; the tarsi with an immense number of joints.

GENUS LV. TARANTULA. Palpi long, simply terminated by a joint in the form of a hook; body short and depressed; thorax reniform or lunated; tail none.

GENUS LVI. THELYPHRONUS. Palpi short and thick, terminated by a finger and thumb; body oblong and cylindrical; thorax oval; tail long.

FAMILY XI. SCORPIONIDES.

Palpi arm-shaped, terminated by a hand armed with a forceps; mandibules with a pair of forceps; all the feet alike in form.

GENUS LVII. SCORPIO. Eyes six or eight; tail jointed; two laminated pectens at the base of the belly.

GENUS LVIII. CHELIFER. Eyes two or four; tail none; pectens none.

GENUS LIX. CELLULARIA.

Observation. Besides the genera above defined, we may add one more, viz. CELLULARIA, a most singular animal discovered by the celebrated zoologist Montagu, inhabiting the cellular membrane of the gannet, (*Pelicanus Bassanus*, Linn.) which is not referable (as far as we can judge from his description) to any of the families hitherto established by Latreille. It appears to be intermediate between *Acarides* and *Ricinides*; we shall, however, quote his description, as given in the first volume of the Wernerian Society's Memoirs, page 191.

"Ovate oblong, smooth, glossy white, with eight short legs, furnished with several joints, and terminated by bristles, two on each side approximating, and near to the anterior end; the others similarly disposed, about one-third of its length from the posterior end: of the posterior legs, the hindermost pair is furnished with a very long bristle, the other pair usually with two; the anterior legs possess several bristles each. No other appendages were discernible under the best constructed microscope, not even the mouth or eyes could be clearly ascertained; but beneath, at the anterior end, from whence the fore legs arise, there are four light depressions, surrounded by dark lines, in the two hindermost of which is a dark spot, but these had not the appearance of eyes; behind this part is usually a fold in the skin, at which place there is an independant motion: the feet are also observed to be in continual alternate motion, whilst under the microscope.

"Size of ACARUS *Siro*, or cheese mite.

"As far as I have hitherto observed, this insect is peculiar to the gannet, and does not appear to inhabit any other part than the cellular membrane: in some subjects it is found in prodigious abundance, together with the ova; and no instance has occurred in which it has not appeared more or less in every specimen dissected.

"To class this animal with any of the Linnæan genera is impossible; nor am I acquainted with any genus, in the arrangement of any of the more modern systematic writers, in which it could with propriety be placed. It appears to be more nearly allied to *Acarus* than any other; but the want of eyes, proboscis or sucker, and palpi, will admit of no connection; the situation, too, of the legs seems to be characteristic. Under these circumstances, I propose giving it a distinct place in the system of nature, under the title of CELLULARIA *Bassani*, with the following generic characters: Head, thorax, and abdomen united; no eyes, antennæ, palpi, nor proboscis; legs eight, the four posterior remote from the four anterior; feet unarmed, but furnished with bristles."

From the above ingenious account, which is accompanied with figures, it is evident that it should form a distinct family, which might with propriety be named *Cellularides*, and be placed, as we have before mentioned, between the *Mites* and *Tiques*.

ORDER I. PODOSOMA.*

Genera and Species.

FAMILY I. NYMPHONIDES.

1. NYMPHON.

GENUS I. NYMPHON. *Fabr. Lamar. Latr.* PYCNOGONUM. *Oth. Fabr. Mall.* PHALANGIUM. *Linn. Mont.*

Mandibulæ armed with a forceps.

Grossipes.

Sp. 1. *Grossipes.* Body smooth; feet very long.

Phalangium grossipes. Linné.

Nymphon grossipes. Fabr. Latr.

Pycnogonum grossipes. Otho Fabricius, Müller.

Inhabits the Norwegian and British seas; is not uncommon on most of our rocky coasts, being often dredged up by the fishermen, who know it by the name of *sea spider.* Fabricius says it perforates the shells of mussels, (*mytilli*,) and sucks out the softer parts of the animal.

Aculeatum.

Sp. 2. *Aculeatum.* Body smooth; feet very long and hairy about the joints.

Phalangium aculeatum. Montagu.

Nymphon hirtum. Fabr.?

Phalangium hirtum. Turton.?

Inhabits the British sea.

Colour, when alive, dusky black; length about four lines.

This species was first noticed by George Montagu, Esq. on the south coast of Devonshire. This is not the *Phalangium spinipes* of Otho Fabricius and Gmelin, as has been supposed by Montagu, that species being referable to the following genus.

FAMILY II. PHOXICHILONIDES.

2. PHOXICHILUS.

GENUS II. PHOXICHILUS. *Latr.* PYCNOGONUM. *Otho Fabr.* PHALANGIUM. *Montagu, Gmel.*

Mandibulæ simple, without a forceps.

Spinipes.

Sp. 1. *Spinipes.* Feet very long and spinous.

Phoxichilus spinipes. Latreille.

Pycnogonum spinipes. Otho Fabricius.

Phalangium spinipes. Gmelin.

Phalangium spinosum. Montagu.

Inhabits the Norwegian and British seas.

This species, which is certainly *Phalangium spinosum* of Montagu, when alive is of a rufous-brown colour, and about a quarter of an inch in length. Two specimens, which were most obligingly communicated by R. Stevenson, Esq. from the Bell-rock light-house, on

* All the animals of this order are marine, and for the most part inhabit deep water or rocky shores: they frequently occur also in pools left by the receding tide. The females of the first tribe are furnished with long jointed ovifera, which Latreille has improperly named spurious feet, the use of which are to carry about their eggs. The same parts are said to be found in the second tribe in *Pycnogonum Balænorum*; but we have never been fortunate enough to detect them in any specimens we have hitherto examined. See *Linn. Trans.* vol. ix. p. 101. where this is noticed by our celebrated zoologist Montagu.

Arachnides.

the Scottish coast, in a living state, were of a blood-red colour, and are possibly distinct.

FAMILY III. PYCNOGONIDES.

3. PYCNOGONUM.

GENUS III. PYCNOGONUM. *Brunnich. Muller. Oth. Fabr. Joan Fabr. Oliv. Lam. Latr.* PHALANGIUM. *Pennant; Gmelin. mandibules* none.

Balænarum.

Sp. 1. *Balænarum.* Body rufous or dusky.

Pycnogonum balænarum. Fabr. Latr.

Phalangium balænarum. Pennant, Gmelin.

Inhabits the rocky shores of the European Ocean, getting under stones, or running on the rocks at low water. It is sometimes also taken by the dredge, in deep water, on many parts of our coasts, but is not common. Mr Sowerby has observed them amongst the oysters in the London shops occasionally. See Plate CCXXI. Fig. 11.

PLATE CCXXI. Fig. 11.

ORDER II. ELEUTEROSOMA.

Eleuterosoma.

FAMILY IV. ASTOMIDES.

A. *Palpi and Rostrum very conspicuous.*

4. CARIS.

GENUS IV. CARIS. *Latreille.* ACARUS. *Geoff.*

Rostrum conic and porrected from the maxillæ.

Palpi somewhat conic, four-jointed, porrected, and as long as the rostrum.

Body coriaceous, somewhat orbicular and depressed.

Vespertilionis.

Sp. 1. *Vespertilionis.* Body brown.

Caris Vespertilionis. Latreille.

Inhabits bats.

5. LEPTUS.

GENUS V. LEPTUS. *Latr.* PEDICULUS. *Scopoli.* ACARUS. *Shaw, Fabricius.* TROMBIDIUM. *Hermann.*

Mouth furnished with a porrected rostrum.

Palpi short and somewhat conic.

Body soft and generally oval.

Phalangii.

Sp. 1. *Phalangii.* Body oval, bright red, with an elevation in front, and two black eyes; rostrum somewhat conic; base of the palpi much thickened; feet nearly equal in length.

Pediculus coccineus. Scopoli.

Acarus Phalangii. Fabricius.

Leptus Phalangii. Latreille.

Inhabits several insects, especially *Phalangium Opilio.*

Obs. To this genus, according to Latreille, all the *trombidia hexapoda* (six-legged trombidia) of Hermann, and the *acarus autumnalis* of Shaw's *Naturalist's Miscellany*, are referable.

B. *No rostrum; the parts of the mouth very obscure.*

. ASTOMA.

GENUS VI. ASTOMA. *Latreille.*

Mouth nearly obsolete.

Body soft and oval.

Feet very short.

Parasiticum.

Sp. 1. *Parasiticum.* Body bright red, somewhat contracted in the middle.

Astoma parasiticum. Latreille.

Inhabits mosses and insects.

II. *Eight Feet.*

FAMILY V. HYDRACHNIDES.

A. *No mandibulæ.*

LIMNOCHARES.

GENUS VII. LIMNOCHARES, *Latreille.* ACARUS, *Linn. Geoff. De Geer.* TROMBIDIUM. *Fabr.*

Palpi bent inward, without appendices.

Rostrum scarcely prominent.

Body depressed, and tomentose.

Feet short, the four posterior ones distant.

Holosericea.

Sp. 1. *Holoserisea.* Body ovate, rough and soft, with two black eyes.

Acarus aquaticus. Linné.

Trombidium aquaticum. Fabricius.

Limnochares holosericea. Latreille.

Inhabits the waters of Europe; is very common in our ponds during the summer months. It varies in colour, but is most frequently found bright red and greyish red, with all the intermediate varieties of shade. Fabricius says it deposits eggs of a red colour, or nepæ, (water scorpions.)

8. HYDRACHNA.

GENUS VIII. HYDRACHNA. *Müll. Oliv. Latr.* ACARUS. *Linn. Geoff. De Geer.* TROMBIDIUM. *Fabr.*

Palpi somewhat cylindrical, porrected, consisting of four joints, the last sharp, and armed with a moveable appendage.

Mouth produced into a porrect, conic rostrum.

Maxillæ two, lengthened, setaceous, and sharp, capable of being concealed by the lip.

Body globular.

Feet placed at an equal distance from one another, fimbriated with hair.

Geographica.

Sp. 1. *Geographica.* Body black, with points and spots of red.

Hydrachna geographica. Müll. Latr.

Trombidium geographicum. Fabr.

Inhabits slowly flowing waters and ponds. The largest species hitherto discovered.

Cruenta.

Sp. 2. *Cruenta.* Body blood red; feet equal.

Hydrachna cruenta of Müller and Latreille.

Trombidium globator. Fabricius.

Inhabits the European waters.

B. *With Mandibulæ.*

9. ELYAIS.

GENUS IX. ELYAIS. *Latr. Lam.* HYDRACHNA. *Müll. Oliv.* TROMBIDIUM. *Fabr.*

Mandibules depressed, armed with a nail at their points, and received within the lip.

Palpi oblong-conic, bent, sharp, and consisting of three or four joints.

Eyes four.

Extendens.

Sp. 1. *Extendens.* Body round, shining, smooth, and red without spots; posterior feet very smooth.

Hydrachna extendens. Müll.

Trombidium extendens. Fabricius.

Elyais Extendens. Lamarck, Latreille.

Inhabits stagnant waters throughout Europe.

Obs. Latreille, in his *Genera Crustaceorum et Insectorum*, says, he suspects the following HYDRACHNÆ of Müller, viz. *undulata, fuscata, maculata, umbrata,* to belong to the genus ELYAIS. This future observers must decide.

FAMILY VI. RICINIDES.

I. *Eyes distinct. Body very soft and thickish, the dorsal skin not coreaceous.*

A. Palpi obscure.

10. SARCOPTES.

GENUS X. SARCOPTES. Latr. ACARUS *of authors.*

Passerinus.

Sp. 1. *Passerinus.* Third feet very thick.

Acarus passerinus. Linn. Fabr. Herm.

Pulex Sturni. Redi (*Opuscul, tom.* 1. *tab.* 2. *fig.* 4.)

Sarcoptes passerinus. Latr.

Inhabits birds.

Scabiei.

Sp. 2. *Scabiei.* Body somewhat round; feet short, reddish; the four posterior ones bearing a very long seta; the anterior four terminated by a club.

Acarus scabiei. Fabricius.

Sarcoptes scabiei. Latreille.

Inhabits ulcers in the itch. A good figure is given by Latreille, in his work entitled *Hist. natural des Crus-*

Arachnides. *taces et des Insectes*, tom. 7. pl. 66. fig. 8. under the name *sarcopte de la gale*.

Obs. To this genus the following species seem to belong, *Acarus exulcerans*, Linné; *Acarus destructor* of Schrank, (*Enumeratio Insectorum Austriæ*, No. 1057.) and *Acarus torosus* of Hermann.

B. Palpi apparent.

11. Bdella. Genus XI. Bdella. *Latr. Lam.* Acarus. *Linn. Fabr.* Scirus. *Her.*

Palpi elongate and generally geniculated, the last joint with two distinct long setæ or hairs.

Mouth with an elongate, depressed, conic rostrum; defended by three valves, or nearly equal lanceolate setæ.

Body ovate, transversely divided into two parts.

Eyes four.

Feet posterior, longer than the rest.

Rubra. Sp. 1. *Rubra.* Antennæ geniculated, the second and third joints very short; the first and last elongate; rostrum longer than the thorax, subulated; body blood red; feet pale.

Bdella rubra, Lamarck.

Acaris longicornis, Linn.?

Inhabits Europe, under stones.

Observe. Scirus longirostris of Hermann, appears to be not very distinct from the above species; p. 62. tab. 6. fig. 12. He mentions two other species, viz. *Latirostris*, and *Setirostris*; the *first* is distinguished by its rostrum being shorter than the thorax; the antennæ three-jointed, the last joint shortest: the *second*, by its subulate rostrum, antennæ with two joints, the apex with one seta. They both inhabit mosses, and are of a red colour.

12. Smaris. Genus XII. Smaris. *Latr.* Acarus *Schrank.* Trombidium, *Hermann.*

Mouth with an elongate, somewhat cylindrical porrected rostrum, with the apex gradually becoming narrower.

Palpi nearly parallel, straight, subcylindrical, and porrected, consisting of four joints, the last with no elongate setæ; they are a little longer than the rostrum.

Body oval and scaly.

Eyes two.

Feet, anterior ones longer; the four hinder distant.

Sambuci. Sp. 1. *Sambuci.* Body red.

Acarus sambuci. Schrank.

Trombidium sambuci, Hermann.

Smaris sambuci, Latr.

Inhabits trees, especially the elder.

13. Cheyletus. Genus XIII. Cheyletus. *Latr.* Acarus, *Schrank.*

Palpi very thick, resembling arms.

Eruditus. Sp. 1. *Eruditus.* Body brownish.

Acarus eruditus, Schrank.

Cheyletus eruditus, Latr.

Inhabits books and musæa.

II. Eyes indistinct. Body with a covering, partly membranaceous, partly coriaceous. The haustellum with three horny laminæ toothed on the side; (these animals suck the blood of mammalia, birds, and reptiles.)

A. Rostrum and palpi obscure.

14. Uropoda. Genus XIV. Uropoda, *Latr.* Acarus, *De Geer, Donovan, Schaw.*

Feet very short (when at rest pressed and contracted against the under part of the body), the fourth longest, then the third; the first very short, received into a cavity on the anterior part of the body beneath.

Body oval, inclining to orbicular; back horny and shield-formed, the middle gradually convex; the under part smooth. The anus fixed to coleopterous insects by a long filiform peduncle. Arachnides.

Sp. 1. *Vegetans.* Body brown, very smooth and shining. Vegetans.

Acarus vegitans, De Geer, Shaw.

Acarus coleoptratorum, jun. Donovan.

Uropoda vegitans, Latreille.

Inhabits sphæridea, histeres, scarabæi, and aphodii.

This curious animal is found on most of the dung-feeding coleopterous insects. Donovan has figured this species for the young of *Gamasus coleoptratorum.*

B. Rostrum and palpi distinct.

Genus XV. Argas, *Latr.* Rhynchoprion, *Herman.* Acarus, *Fabr.* 15. Argas.

Palpi conic, short, incurved, consisting of four joints.

Body oval, membranaceous, the skin not more coreaceous before than behind.

Feet arising from nearly the middle of the vertex, with two nails at their extremities, inserted and elongated, the joints rounded at their base.

Sp. 1. *Reflexus.* Pale yellowish, or flesh-coloured inclined to violet; body marginated, the squamulæ very short, the sanguiferous vessels branched. Reflexus.

Acarus marginatus, Fabr. Coquebert.

Argas reflexus, Latr.

Inhabits houses, sucking the blood of pigeons.

Observe. Latreille thinks it highly probable that *Acarus niger* of De Geer, (tom. 7. pl. 37. fig. 9.), and *Rhyncoprion americanum* of Hermann, (p. 71.) form an intermediate genus between *Argas* and the following genus *Ixodes.* Should this be found correct, it might be named *Rhychoprion*, which would prevent any useless confusion arising from synonyms.

Genus XVI. Ixodes, *Latr.* Acarus, *Lin. Fab. Oliv.* Cynorhestes, *Herm.* 16. Ixodes.

Palpi terminal, porrect, very short, coriaceous, plain, depressed, longer than broad, nearly of an equal breadth, the apex rounded or obtuse, inserted at the base of the haustellum on a common peduncle, sheathing the haustellum and rostrum.

Rostrum oblong-quadrate, depressed, obtuse, three-jointed; the basilar joint very small; the others nearly equal; the internal edge hollow.

Haustellum horny, with three lamellæ.

Body ovate-orbicular, membranaceous before, and notched for the insertion of the rostrum; the anterior part of the back coriaceous, somewhat resembling a thorax.

Feet inserted at the lateral margins, the joints thick; the last, with two nails, inserted on a vesicle; the vesicle pedunculated.

Sp. 1. *Ricinus.* The rostrum, thoracic mark on the dorsum, and feet blackish red; the abdomen light red, with a few scattered villi, the sides marginatis; the palpi free, or scarcely sheathing the haustellum. Ricinus.

Acarus ricinus, Linn. Fabr.

Ixodes ricinus, Latr.

Inhabits the woods and groves of Europe, attaching itself to oxen and dogs, and adhering firmly by their rostrum and feet. Is very common in Britain; is known by the names tick, or dog-tick, or tique.

Sp. 2. *Sanguineus.* Blood red, and punctated or dotted, with three impressed lines behind; the dorsum without any distinct mark on the anterior part. Sanguineus.

Inhabits France, and is here given on the authority of that celebrated entomologist Latreille, who says it is rather smaller than the preceding species.

Reticulatus. *Sp.* 3. *Reticulatus.* Bright blood red beneath, above whitish, variegated, with brownish blood colour; the dorsal marks obscurely marginated; the sides of the abdomen marginated, punctated, and striated; palpi somewhat oval.

Acarus reticulatus, Fabr.
Acarus reduvius, Schrank.
Ixodes reticulatus, Latr.

Inhabits various plants; is very common in Genistæ; it fixes itself to oxen. When its abdomen is distended, it is nearly five lines in length, and is then of an ash or pale yellow colour.

Family VII. Acarides.

I. Palpi very short, not exserted.

17. Acarus. Genus XVII. Acarus, *Linn. Geoff. De Geer. Fabr. Oliv. Hermann.*

Body soft; parts of the mouth naked.

Tarsi with a pedunculated vesical at the apex.

Siro. *Sp.* 1. *Siro.* Whitish, with two brown spots; body oval, contracted in the middle, with very long hairs; feet equal in length.

Acarus siro, Linn. Fabr.
Ciron du fromage, Geoff.
Acarus domesticus, Latr.

Inhabits cheese and flour too long kept. Is called cheese-mite, and much esteemed by most people, who say it heightens and improves the flavour of cheese. Latreille supposes *Acarus dimidiatus* of Hermann may be this species.

Farinæ. *Sp.* 2. *Farinæ.* Oblong and white; head reddish; feet conical, thicker, and of an equal length.

Acarus farinæ, Schrank, Latreille.
Acarus favorum, Hermann?

Observe. Are *Acarus lactus* and *Dysenteriæ,* of Linné and Fabricius, distinct from *Acarus farinæ* of Latreille? They are probably merely the young of that species.

18. Oribita. Genus XVIII. Oribita, *Latr.* Acarus, *Linn. Fabr. Oliv. Geof.* Notaspis, *Her.*

Body with a coriaceous covering, (back generally shielded,) rostrated before; the rostrum including the parts of the mouth.

Tarsi, generally with three nails at their extremities.

* *Abdomen somewhat globose, neither angulated in front, nor furnished with wing-like processes.*

Geniculata. *Sp.* 1. *Geniculata.* Brownish red, shining and hairy; feet pale-brown; thighs rather clubbed.

Acarus geniculatus. Linn.
Oribita geniculata. Latreille.

Inhabits trees and stones in various parts of Europe.

Theleproctus. *Sp.* 2. *Theleproctus.* Black; back clypeated; the shield divided and striated by concentric circles.

Notaspis theleproctus. Hermann.
Oribita theleproctus. Latreille.

Inhabits France and Scotland. Its form is that of a shield, its motion very slow.

Cassidea. *Sp.* 3. *Cassidea.* Brownish-red; scutum depressed and transparent; anterior feet antennæ-like.

Notaspis cassidea. Herm.
Oribita cassidea. Latr.

Inhabits mosses. Is found in France and Britain; in the latter country it is very common.

** *Abdomen somewhat globose; the anterior margin produced into an angle, or wing-like process.*

Alata. *Sp.* 4. *Alata.* Abdomen very smooth; obscurely brownish red; the sides with wing-like processes.

Acarus coleoptratus. Linn.
Oribita alata. Latr.
Notaspis alata. Herm.

Inhabits mosses.

Sp. 5. *Humeralis.* Abdomen blackish-brown-red, and very smooth; the sides produced into a straight angular membranaceous process. Humeralis.

Notaspis Humeralis. Herm.
Oribita Humeralis. Latr.

*** *Abdomen somewhat quadrate, neither angulated nor winged.*

Sp. 6. *Tegeocrana.* Abdomen oblong; the anterior margin with four white setæ; the head covered by a triangular scutum; the lateral squamula pellucid. Tegeocrana.

Notaspis tegeocrana. Herm.
Oribita tegeocrana. Latr.

Inhabits mosses.

Sp. 7. *Horrida.* Body rough; abdomen with two teeth behind, and four hooked processes. Horrida

Notaspis horrida. Hermann.
Oribita horrida. Latreille.

Inhabits mosses. In this country it appears to be very rare, having been found but once in a wood in Norfolk, near Cossey, by Mr Leach.

I. *Palpi exerted and prominent.*

A. No moveable appendage at the extremity of the palpi.

Genus XIX. Gamasus, *Latr.* Acarus, *Linn. Fabr. Oliv. Herm.* Trombidium, *Herm.* 19. Gamasus.

Pulvilli vesicular at the apex of the tarsi.

* *Body depressed; the whole, or part of the skin of the back, coriaceous.*

Sp. 1. *Coleoptratorum.* The anterior part of the back, and a triangular spot behind, coriaceous and fuscous; the anterior and posterior pair of feet rather longer than the rest. Coleoptratorum.

Acarus coleoptratorum. Linn. Fabr. Donovan. Herm.
Gamasus coleoptratorum. Latr.

Inhabits the dung of oxen and horses, attaching itself to such coleopterous insects as come there to feed or deposit their eggs. We have frequently seen Geotrupes *stercorarius,* (the common clock, or dor beetle,) and Necrophorus *vespilo* and *humator,* (grave-digging beetles,) nearly covered by hundreds of these animals.

Sp. 2. *Marginatus.* Oval, brown, and hairy; coriaceous above and below; the sides of the abdomen being alone membranaceous and white; the anterior feet nearly twice as long as the rest. Marginatus.

Acarus marginatus. Hermann.
Gamosus marginatus. Latreille.

Inhabits dung and putrescent plants, where it frequently occurs. Latreille supposes *acarus cellaris* of Dr Hermann is the same insect; it differs, however, in having very unequal feet, and an immarginate body; if his figure therefore be correct, it is a distinct species.

Sp. 3. *Crassipes.* Second pair of feet very thick and toothed. Crassipes.

Acarus crassipes. Hermann.
Gammasus crassipes. Leach's MSS.

Obs. To this family, *acarus testudinarius* of Hermann, (tab. 9. fig. 1.) and *acarus longipes,* (tab. 1. fig. 8.) of the same author appear to belong; but as we have never seen the animals, we cannot be too cautious in giving our opinion.

** Body with a soft skin, back not coriaceous.

Obs. We are unacquainted with all the members composing this family; and shall therefore give Latreille's ideas on the species which he supposes to belong to it. "Some few of the Trombidia and Acari of Hermann

Arachnides.

and Fabricius may be referred to this family. I have not examined the species with sufficient attention, the following list I therefore give with doubt, viz. *Trombidium.* 1. *Trimaculatum.* 2. *Miniatum.* 3. *Parietinum,* (*Acarus baccarum,* Linn.?) 4. *Congenericum.* 5. *Lapidum.* 6. *Telarium.* 7. *Sociale* of Hermann. *Trombidium trimaculatum* is figured by Rossi. *Acarus Hirundinis,* and *Vespertilionis* seem to form a distinct genus."

B. A moveable appendage at the extremity of the palpi.

20. Erythræus. GENUS XX. ERYTHRÆUS, *Latr.* ACARUS, *De Geer.* TROMBIDIUM, *Herm.*

Eyes two, sessile.

Palpi elongate and conic; the under part of the last joint armed with a chelate moveable appendage.

Body entire; the division between the two anterior pair, and posterior pair, not very remarkable.

Phalangioides. *Sp.* 1. *Phalangioides.* Feet very long, the last joint broad and compressed; the hinder, and then the anterior, longest; body obscurely red, with a yellowish orange band.

Trombidium phalangioides. Hermann.

Erythræus phalangioides. Latreille.

Inhabits the ground, running with rapidity; is found throughout the greater part of Europe; found by Mr Leach at Swansea.

21. Trombidium. GENUS XXI. TROMBIDIUM, *Fabr. Oliv. Lam. Latr. Herm.* ACARUS, *Linn.*

Eyes four, two on each side, pedunculated.

Palpi elongate-conic, inserted at the base of the posterior sides of the lip; consisting of four joints, the first very short, the second larger than the third, the last conic; the point (at least) horny, nail-shaped, acute; the base with a moveable cylindrical appendage.

Body divided into two parts; the anterior part thoracic, stronger and narrower, bearing the mouth, eyes, and four anterior feet; the posterior part abdominal, broader, very soft, bearing the four posterior feet, which are at a notable distance from the others.

Observe. Besides the above character, which is essential, we may subjoin the following. Mandibulæ two, compressed and horny, incurved at their base. Lip (*labium*) membranaceous, somewhat conic, sheathing the mandibulæ. Feet six, jointed, with two very short nails, which are compressed and arched, being concealed in a fissure in the middle of the apex of the tarsus; the anterior ones generally longest.

Tinctorium. *Sp.* 1. *Tinctorium.* Body somewhat quadrate; blood red, immaculate, and covered by a velvety down; the hairs setaceous, elongate, and bearded.

Acarus tinctorius, Linné.

Trombidium tinctorium, Fabr. Herm. Latr.

Inhabits Guinea; is often preserved amongst collections of insects from that place, whence we infer it is not an uncommon species. Its colour is destroyed by alcohol.

Holosericeum. *Sp.* 2. *Holosericeum.* Body somewhat quadrate; blood red, without spots, and tomentose; the down short, composed of hairs, or cylindrical papillæ, rounded or obtuse at their points.

Inhabits Europe; common, in the spring, on walls and trees in gardens. It is the *Acarus holosericeus* of Linné; *Trombidium holosericeum* of Fabricius, Hermann, and Latreille.

Fuliginosum. *Sp.* 3. *Fuliginosum.* Body elongate-quadrate, of an immaculate obscure red colour, and tomentose; the down short, with bearded hairs.

Trombidium fuliginosum, Hermann, Latreille.

Arachnides.

FAMILY VIII. PHALANGIDES.

I. EYES not placed on a common peduncle, but at some distance from each other.

22. Siro. GENUS XXII. SIRO, *Latreille.*

Mouth naked, with two mandibules, which are double-jointed, cylindrical, and compressed, with their points armed with forceps placed between two long narrow maxillæ, which are marginated on their inner edge.

Palpi two, composed of five elongate joints, the second the longest.

Body oval.

Eyes two in number, situated on the sides of the thorax, on an erect tubercle, at a distance from one another.

Abdomen annulated above and below.

Feet elongate and filiform; the tibiæ and tarsi consisting of two joints; the last larger and clavate, being armed with a bent nail.

Sp. 1. *Rubens.* Pale red; feet lighter coloured. Rubens.

Siro rubens, Latreille.

Inhabits France, harbouring under moss at the roots of trees. Length about a line.

GENUS XXIII. TROGULUS, *Latr.* PHALANGIUM, *Linn. Fabr.* 23. Trogulus.

Mouth situated in a cavity under the anterior part of the thorax, furnished with two mandibulæ, palpi, and maxillæ.

Mandibles cylindrical, elongate, compressed, double-jointed and kneed, the last joint armed with a forceps, and nearly equal chelæ.

Palpi filiform, a little longer than the mandibulæ, inserted at the internal lateral base of the maxillæ, and consisting of five joints; the first very short; the second very long and cylindrical; the third and fourth of a moderate and nearly equal length, of a cylindrico-conical form, the fourth a little longer; the last cylindrical, inclining to oval, armed at the apex with a very minute horny nail.

Maxillæ somewhat horny, oval, spoon-shaped, marginated, and divaricating.

Lip-like body; at the angle of separation small, membranaceous, and nearly round; seemingly formed of two moon-shaped parts joining together, the intermediate space receiving the apex of the chelæ.

Body ovate-elliptical, depressed, marginated in front, rounded at the apex.

Eyes two, placed at a short distance from one another on the back, the insertion scarcely prominent.

Feet eight, elongate, filiform, each arising from a common base separate from the pectus; the second and fourth pair longest, and of nearly an equal length; next the third, then the first: The tibiæ and conæ consisting of two, the tarsi of three joints; the first joint of the latter, and then the last, longest; last joint of tarsus armed with a nail.

Sp. 1. *Nepæformis.* Obscure-cinereous, or brownish; the dorsum and sides of the abdomen obscurely carinated; the external apex of the first joint of the tarsi lengthened. Nepæformis.

Phalangium tricarinatum, Linné.

Phalangium carinatum, Fabricius.

Acarus nepæformis, Scopoli.

Trogulus nepæformis, Latreille.

Inhabits France and Germany, lurking under stones. It has not hitherto occurred in this country.

II. *Eyes placed on a common peduncle, very close together.*

Arachnides.

24. Phalangium.

Genus XXIV. Phalangium, *Linn. Fabr. Latr. Herm. Don.*; Opilio, *Herbst.*

Mouth consists of a labriform rostellum; two mandibulæ and palpi; six parts which appear to be maxillæ; a labium and sexual vagina.

Rostellum labriform, horny, short, conic, and inserted under the mandibules, above the maxillæ, in the middle of the origin of the palpi; the apex acuminated.

Mandibulæ porrect, horny, somewhat cylindrical, compressed, elongate, double-jointed, inflexed at the second joint, inserted under the middle of the interior margin, being longitudinally contiguous; the apex armed with a forceps; the chelæ conic and equal; the thumb or external chela moveable.

Palpi inserted at the base of the first maxillæ, under the origin of the mandibulæ; they are composed of five joints, which are nearly filiform, the third being excepted, which is cylindrical; the first very short, the second and last longer, the third shorter and nearly conic.

Maxillæ (organs resembling them in form) placed in a double order, closing the aperture of the mouth by meeting transversely; they are very short and membranaceous; the four upper ones vesicular and intumescent, with the base somewhat cylindrical and thickened; the apex rounded and hairy; a small, erect, conic, needle-like process at the base of the upper pair; the lowest pair narrow, elongate, lanceolate, and slightly connected together, arising from the origin of the second pair of feet, and resting on the apex of the sexual vagina.

Labium concealed by the maxillæ; on dissection it is quadrate and membranaceous, the apex being rounded, with the middle notched.

Vagina sexual, including the sexual organ of the male and oviduct of the female, is placed under the maxillæ, causing a prominence on the middle of the pectus, resembling a sternum.

Body somewhat orbicular or oval, covered by a soft semicoriaceous skin, the breadth rather exceeding the height.

Thorax semicircular, with a tubercle on the middle towards the hinder margin, on which the eyes are placed, one on each side.

Abdomen folded or wrinkled beneath.

Feet eight, very long and narrow; the second pair longest, then the fourth, next the third and first. The conæ composed of three, the tibiæ of two joints; the tarsi of several, the basilar or first one longest; nail small, horny, and bent, placed at the extreme apex.

* *The second pair of feet about six times longer than the body; all the tarsi hair-like; the inferior joints elongate, four times as broad as long.*

Opilio.

Sp. 1. *Opilio.* The eye-bearing tubercle with a double crown of little spines; body oval; thighs distinctly bearing spines disposed in many longitudinal series; back cinereous or testaceous, the middle of the abdomen blackish; the spines of the eye-bearing tubercle very conspicuous; eyes rather distant; the space of the thorax passing them not abruptly elevated; anterior tibiæ angulated (of the female with a groove); second joint of the palpi generally with a blackish or obscure spot.

Male, *Phalangium cornutum*, Lin. Fab. Hermann.

Female, *Phalangium opilio*, Linn. Fab. Hermann.

Inhabits Europe, is frequent on walls or amongst grass. The male has the second joint before the apex of the mandibles transversely and longitudinally fixed to the preceding; and palpi as long as the body. These sexual distinctions (which most probably apply to the whole genus) were observed by that celebrated observer of nature Geoffroy.

Observation 1. Latreille says, that he has observed a species much allied to *Phalangium opilio*, differing, however, by having the anterior feet nearly cylindrical, and not distinctly angulated, and the third and fourth joints of the palpi, especially the former, produced at the apex internally into a horn or branch, as in *Phalangium uncato* of Hermann, (*Mém. Aptér.* page 106, plate 8, fig. 5,); the second joint of the same colour with the rest; the upper part of the body somewhat nut-coloured, with paler spots; the back not black in the middle; the thighs less spiny. It appears to be nearly allied to Hermann's species above alluded to; the individual mentioned by Latreille was a female.

Observation 2. *Opilio longipes*, Herbst. (*Naturg. opil.* tab. 2. fig. 2.) is distinguished from *Phalangium opilio* by its pale nut-colour without the black dorsal mark; by the shorter spines of the eye-bearing tubercle; the eyes more approximated, reddish, with a black spot interposed; the space before them abruptly elevated; the second joint of the palpi of the same colour with the rest; the anterior tibiæ cylindrical and somewhat spinous. This is supposed to be a mere variety of *Phalangium opilio* by Hermann.

Observation 3. *Phalangium cornigerum* of Hermann, is readily distinguished from the male of *Phalangium opilio*, by its spiny palpi, the internal apex of the third and fourth joints prominent; the second joint of the mandibules before the apex near the chelæ elevated into a horn above. Latreille thinks this may be the male of *Phalangium uncatum.*

Sp. 2. *Rotundum.* The eye-bearing tubercle smooth and black; body orbicular-oval, above testaceous, the dorsum testaceous, that of the female with a black spot of a quadrate form, spotted with pale colour; base of mandibules with two teeth on the upper part; feet very slender and black, the extremities of the joints of the thighs and tibiæ generally whitish. Rotundum.

Phalangium rotundum, Hermann, Latreille.

Inhabits France, is common in a wood called St Germain, and at Petit-Gentilly. It has once occurred in Scotland, in Ravelston wood, near Edinburgh; it is probably rare in Britain.

** Second pair of feet three, four, or more times as long as the body; tarsi with the fourth, fifth, and following joints a little elongated, twice as broad as long.

Sp. 3. *Histrix.* The eye-bearing tubercle a little elevated, obscurely crowned with granulations; body quadrate-oval, the back cinereous or yellowish-grey; the coxæ and sides of the thorax spiny; the middle of the anterior margin itself, with three porrect close-set spines; feet pale yellowish, with obscure spots; the tibiæ angular; tarsi with thirty joints or more. Histrix.

Phalangium histrix of Hermann and Latreille.

Inhabits France and Britain; it is a common species, frequently occurring under stones, on walls, &c. The female has a quadrate black spot on its back. *Phalangium cristatum* of Olivier (*Encyclop. Méthodique*), and *Opilio hispidus* of Herbst. (tab. 3. fig. 1, 2.), belong to this division.

Sp. 4. *Quadridentatum.* The eye-bearing tubercle and base of the palpi and feet spiny; body oval, de- Quadridentatum.

Arachnides.

pressed, obscurely cinereous; the anterior middle of the anterior margin of the thorax with a strong elevated spine; the abdomen with a quadruple row or series of tubercles; the apex armed with four teeth; the tarsi of the second pair of feet with about seventeen joints.

Phalangium quadridentatum, Cuvier, Fabricius, Latreille.

Inhabits the south of France; is found under stones, and, according to Latreille, is rare in the environs of Paris.

Bimaculatum. *Sp.* 5. *Bimaculatum.* Body bluish-black, with two white spots; the tarsi somewhat clubbed at their extremities.

Phalangium bimaculatum, Fabricius, Donovan, Hermann.

Inhabits Europe. In this country it very frequently occurs under stones during the whole year; is more abundant in Scotland than in England.

25. Galeodes. Genus XXV. Galeodes, Oliv. Lam. Latr.; Phalangium, Pallas; Solpuga, Fab. Herbst.

Mouth provided with two mandibules and maxillæ, with palpi, and an under lip.

Palpi very large, feet-like and porrect, nearly as long as the hinder feet; filiform composed of five joints, inserted on the apex of the maxillæ; the first joint very short; the three following cylindrical, elongated; the third and second longer, especially the latter; the last very short, cylindrico-conical; the apex rounded, without a nail, and somewhat fleshy.

Mandibulæ horny and oval, externally convex, internally plain, bearing two chelæ, which are very bare and porrect; the chelæ more horny, very strong, and tooth-shaped, of the length of the mandibules, compressed; the apex very acute, arcuated, the internal side strongly toothed.

Maxillæ resembling coxæ, short, thick, and cylindrical, contiguous at their base, at which point they diverge; the internal angle at the apex lengthened into a little conic villose tooth.

Labium small, horny, compressed, and exserted between the maxillæ at the point at which they diverge; the apex bearing one tooth; the tooth evident, bent downwards; the anterior aspect of the lip bearing two small laciniæ, with two needle-like, moveable, vilose processes at their point.

Body elongate, soft, with the skin folded in rings.

Thorax having its anterior segment large, resembling a head, covered with a hard scutum of a triangular shape, broad before, truncated behind, on which the eyes are placed, the lower part bearing the mouth and anterior pair of feet.

Abdomen oblong-oval, with eight or nine folds.

Eyes four, placed on a transverse tubercle in the anterior part of the thorax; two larger, opposite, contiguous, and circle, with the pupil elevated and somewhat granular, the iris radiated; the other two very small, intermediate, below resembling stemmata.

Feet elongate and filiform (the anterior pair excepted), double or twins being transversely connected at their base; the tibiæ consisting of two elongate joints; the tarsi short, formed of two or three joints, the last with two filiform arched fingers, armed at their points with horny nails; the four anterior feet nearly equal and small; the third pair somewhat longer than the second; the fourth longest.

Observation. The upper part of the mandibules at the base of the chelæ bearing cirrhi; body villose; the palpi and feet bearing elongated hairs resembling spines, taking their origin from a glandular elevation. Latreille says this genus is called *Phax* by Hermann.

Araneoides. *Sp.* 1. *Araneoides.* Body pale yellow, mixed with ash-grey.

Phalangium araneoides, Pallas.
Solpuga araneoides, Fabr.
Solpuga arachnoides, Herbst.
Galeodes araneioides, Latreille.

Inhabits the Cape of Good Hope; a variety, or more probably a distinct species, nearly allied to this, occurs in Russia.

Family IX. Araneides.

The animals of this family are familiarly known under the general denomination of *Spiders,* and, as we have before mentioned, were included by Linné, Fabricius, and other authors, in one genus, which they called *Aranea.* As the species are very numerous, they were obliged to divide them into families, which were distinguished by the situation of their eyes, which in this family are generally eight (sometimes only six) in number, and are immoveable; they consist of but one lens, which deprives them of the faculty of multiplying objects, as their immobility does that of seeing them if placed otherwise than exactly before them; so that a number of eyes placed on different aspects, is essential to enable them to look on every side, to avoid danger and to see their prey.

As these animals are more interesting than any others in this class, we shall give our readers an account of their economy and habits, as given in the works of Dr Lister, Geoffroy, Reaumur, Dr Hulse, Lyoneret, Dr Mead, and others.

Spiders change their skin annually, and their skins are often found in their webs, being dry and transparent, having their mandibules attached to them. When about to cast their covering, they suspend themselves in some corner, and creep out at a crack which takes place on their back, gradually withdrawing their legs from the skin, as if it were a glove.

The webs of spiders are too well known to need much description: the mode of weaving these nets is however very interesting. For this purpose, they are provided with five teats or nipples at the extremity of their body, the apertures of which they can dilate or contract at pleasure. Through these holes they emit a gluey matter, which is contained in a bag communicating with the teats. They attach the end of their threads by applying their nipples to any substance, and the threads are lengthened as the animal recedes from it, and are immediately hardened from exposure to the air. They can stop the spinning by contracting the nipples, and can ascend the cord they have spun with wonderful facility. The mode of spinning peculiar to the different species, will be particularly noticed when treating of the animals themselves. Some species have the power of darting long threads to an immense distance, by means of which they can convey themselves across rivers or chasms, which has given rise to the vulgar notion of the flight of spiders. Dr Lister relates, that, attending minutely to a spider at work weaving its net, he observed it suddenly desist; and, turning its nipples to the wind, dart out a thread with the violence of a water jet: This thread, taken up by the wind, was carried to some fathoms length, still issuing from the body of the animal. Some time after the spider leapt into the air, and the thread mounted her up swiftly. He afterwards made the same observation on about thirty other species of spiders, and found the air filled with young and old sailing on their threads, and probably seizing insects in their passage, as he found legs and wings, and other manifest signs of slaughter, on those threads, as well as in the webs below. These observations were corroborated by Dr Hulse, who made the like discovery about the same time. It is Dr Lister's opinion, that this darting of threads was known to Aristotle and Pliny, (vide Aristotle, *Historia Animalium*, lib. ix. cap. 89. and *Plinius*, lib. x. cap. 74.); but believes their sailing was first observed by himself. On these sailing spiders he farther observes, that they will often dart not a single thread alone, but a whole sheaf at once, consisting of many filaments, all of one length, but divided from each other and distinct; and the longer they become, the more they spread, and appear like the numerous rays of a blazing star. He observed, too, that some species seemed to use their legs as oars, sometimes closing, and again spreading them out, as occasion might require. When the air is still, it is highly probable they can direct their course, and perhaps mount or descend at pleasure. In rowing, he observed they always take their flight backwards. These threads mount to an almost incredible height, and may always be observed in a fine clear day in autumn, when there is little or no wind. In a letter to Mr Ray, he farther observes, "that I one day observing the air full of webs, forthwith mounted to the top of the highest steeple on the minster (at York), and could there discern them exceedingly high above me." Thus have we briefly stated the observations of this celebrated naturalist, to which we may add his conclusions: They mount their threads upwards, and mount them in a line almost perpendicularly. This is not all; they also project them in a line parallel with the horizon, as may be seen by their threads running from one wall to another in a house, or from one tree to another in a field or garden. By what power this is done he does not attempt to show: It only, as he observes, "magnifies our ideas of that Being, who has given to so apparently contemptible an animal such vast powers for its maintenance and pleasure."

The apertures from which the web is produced are, according to Reaumur, very numerous. He says there are, in the compass of a pin's head, enough to yield an amazing number of distinct threads. These holes are perceived by their effects: Take a garden spider ready to deposit its eggs, and apply the finger to one of the papillæ or teats, and as you withdraw your finger, a vast many distinct threads will appear. Reaumur has often counted seventy or eighty by the assistance of a microscope; and perceived a vast many which he could not distinctly count. He says, that were he to say each teat has a thousand apertures, he should say too little. Each nipple is covered with minute prominences, and each of these probably has a vast number of openings; or between its several protuberances are holes, which give vent to threads: The use of these prominences may be to keep the threads asunder, at their first exit, before they are hardened by the air; and this is rendered very probable, as some spiders are provided with tufts of hair instead, which may serve the purpose of keeping the threads at a proper distance from one another. Leeuwenhoek has computed, that one hundred threads of a tolerably sized spider are not equal to the diameter of the hair of a man's beard, and, consequently, if the threads and hair be both round, ten thousand such threads are not larger than such a hair. And as young spiders (which are not, when first hatched, altogether as large as a single papillæ of the mother which produced them,) spin as soon as they quit the egg, he farther calculates, that as four hundred young ones are not larger than one full grown, four millions of their threads are not so thick as a hair of a man's beard. Some experiments have been made to manufacture the threads of spiders into silk; these we shall detail when their natural history is concluded.

The use of the webs above described, seems to be principally for the purpose of taking their prey, and defending them from the attacks of birds, some kinds constructing strong webs for that purpose. Their food, in every stage of their existence, consists of insects; nor do they spare their own species, preying on one another with the most savage ferocity. These inherent qualities create a disgust which even the expansion of philosophy will not always suppress. Thomson probably felt this sympathy of the mind, in his description of the spider:

" ——— To heedless flies the window proves
A constant death; where gloomily retired,
The villain spider lives, cunning and fierce,
Mixture abhorred! amid a mangled heap
Of carcases, in eager watch he sits,
O'er-looking all his waving snares around.
Near the dire cell, the dreadless wanderer oft
Passes, as oft the ruffian shews his front;
The prey at length ensnared, he dreadful darts
With rapid glide along the leaning line;
And fixing in the wretch his cruel fangs,
Strikes backwards grimly pleased; the flutt'ring wing,
And shriller sound, declare extreme distress,
And ask the helping hospitable hand."

The weapons with which they seize their prey, is a pair or sharp crooked claws or forceps placed in the front of the body. These they can open as occasion may require; when at rest, they lie one over the other. Leeuwenhoek says, that each of these claws has a small slit or aperture, through which a poisonous juice is injected into the wound they inflict. Dr Mead, in his *Essay on Poisons*, dissents from this altogether, having never been able, on repeated examinations, to discover any such opening, not even in the claws of the largest species. We have likewise investigated this point, and find that in many species there is a groove; but we are very confident it is nothing more, never having been able to discover any opening in the groove, after repeated examinations. Dr Mead says, that a small proboscis is thrust out of the mouth at the time the spider inflicts the wound, and infuses poison into it. Whether this be correct or not we shall not pretend to say, never having examined any of the large exotic species in a recent state; in our own species, nothing of the sort has hitherto occurred.

The part of generation of the male spider resides at the extremities of the palpi, which open, as it were, with a spring during the act of copulation; those of the female are situated under the abdomen. As these animals prey on each other except during the time of their amours, they dare not come within reach of one another but with the utmost caution. Some species may be observed, stretching out their legs, shaking the web, and tampering with one another by a slight touch with the extremity of their feet; then in a fright dropping down their thread and returning in a few minutes to make a fresh trial by feeling. When both parties are well assured of the sex they have to deal with, the approaches of their feet in order to feel are more frequent; confidence takes place, and amorous dalliance ensues. "We cannot," says Lyonnet, "but admire how careful they are not to give themselves up blindly to, or venture on, an imprudent step which might become fatal to them."

As to the employment of spiders threads in place of silk, Bon of Languedoc, about eighty years ago, made a pair of stockings and gloves from the threads of some species of spider; they were of a fine grey colour, and nearly as strong as those of common silk: on this discovery, he published a dissertation. Reaumur, who was appointed by the Royal Academy to examine into the merits and probable advantages which might arise from such a manufacture, urged the following objections and difficulties against it, which are published in the Memoirs of the Academy for the year 1710:—The natural fierceness of the spiders renders them unfit to be bred and kept together. Four or five thousand being distributed in cells, fifty in some, one or two hundred in others, the big ones soon killed and eat the smaller ones, so that in a short time there were scarcely above one or two left in each cell; and to this inclination of devouring their own species, he attributes the scarcity of spiders when compared with the vast number of eggs they lay. He affirms also, that the web of the spider is inferior in strength and lustre to that of the silk worm, and produces less of the material fit for use. The thread of the spider's web, he says, can only bear a weight of two grains without breaking; and the bag sustains the weight of thirty-six grains: the thread of a silk worm will bear two drams and an half, so that five threads of the spider are necessary to form a cord equal to that of a silk worm; as it would be impossible to apply these so closely together as to avoid leaving any empty space between from which the light would not be reflected, and consequently would throw out much less lustre: this was noticed at the time the stockings were presented to the society by M. de la Hire. He further remarks, that spiders afford less silk than silk worms: the largest bags of the latter weigh four grains, the smaller three grains; so that two thousand three hundred and four worms produce a pound of silk. The bags of a spider weigh about one grain; when cleared of the dust and filth they lose two thirds of that weight. The work of twelve spiders, therefore, only equals that of one silk-worm; and a pound of silk will require at least twenty-seven thousand six hundred and forty-eight spiders. But as the bags are solely the work of the females, who spin them to deposit their eggs in, there must be kept 55,296 spiders to yield one pound of silk; yet this will apply to the good ones only; those spiders in gardens most commonly scarcely yielding a twelfth part of the silk of the domestic kinds. Two hundred and eighty, it seems, would not produce more than one silk-worm; six hundred and sixty-three thousand, five hundred and fifty-five of them, would scarcely yield a pound.

From the above memoir it seems that the manufacture of silk from the European spiders would be attended with more trouble than profit; yet the webs of the large species inhabiting the tropics might probably be turned to good account, as we learn from Sir George Staunton's embassy to China, who, when speaking of the Java forests, says, "in some open spots were found webs of spiders even with threads of so strong a texture as not easily to be divided without a cutting instrument; they seemed to render feasible the idea of him who, in the southern provinces of Europe, proposed a manufactory of spider's threads, which was so very ridiculous to the eyes of those who have only viewed the flimsy webs such insects spin in England."

Having given an account of the animals which compose this family, as far as relates to their general history and economical uses, we shall proceed to define the genera, as given in the works of Walckenaer, Lamarck, and Latreille, the characters being deduced from the positions of the eyes, length of the different feet, figure and structure of the maxillæ, &c.; and when describing the species, we shall notice any peculiarities in their form, structure, or economy.

Their use in the economy of nature appears to be principally that of preventing the two great increase of other insects.

I. Feet not formed for leaping.

GENUS XXVI. MYGALE, *Latr. Walck.* ARANEA, *Lin. Fab. Lam. Oliv.* 26. MYGALE.

Labium very small and quadrate, inserted under the base of the maxillæ.

Palpi attached to the apex of the jaws.

A. The nails of the tarsus with few very obscure or no teeth on the under side.

* Mandibulæ without any apical rostellum; the under part of the last joint of the palpi and tarsi with a hairy scopula.

Sp. 1. *Avicularia.* Body covered with long and thick black hair; apex of the tarsi and feet rust coloured; tarsi broad; nails not exserted. Avicularia.

Aranea avicularia of Linné and Fabricius.

Aranea hirtipes, Fabricius, *Ent. Syst.* tom. ii. p. 420.

Mygale avicularia, Latreille, Walckenaer.

Inhabits South America, where it is well known under the names *Araignée aviculaire,* or *bird-catching spider.* Of its natural history we know nothing; it is the largest species discovered, being often found with a body as large, or even larger, than a goose's egg. It is said to spread a strong web between the trees in woods, in which it takes small birds as well as insects. The male's parts of generation are globose.

Sp. 2. *Cancerides.* Brown and hairy, the under part of the abdomen, with the breast, blackish. Cancerides.

Mygale cancerides, Latreille.

Inhabits the island of St Domingo, where it is called *araignée-crabe.* The genitalia of the male are produced into a horny-arched nail, the apex compressed, the foot-stalk a little longer than in the foregoing species.

Sp. 3. *Blondii.* Covered with rust-coloured hair; the basilar joint of the tarsi (especially of the posterior feet) with visible black spines. Blondii.

Inhabits Cayenne.

Mygale Blondii, Latreille.

Mygale de la Blond, Walckenaer.

Described and figured in the genera *Crustaceorum et Insectorum* of Latreille, (vol. i. tab. 5. fig. 1.) and in Walckenaer's work, p. 4. The genitalia of the male are somewhat conic and thick, the apex laterally excavated.

Sp. 4. *Fasciata.* Abdomen with a broad greyish longitudinal band, with the margins notched or sinuated. Fasciata.

Arachnides.

Mygale faciata, Latreille.

Mygale faciée, Walckenaer, p. 4.

Said by Seba, who has given a figure of this species, (tom. i. tab. 69. fig. 1.), to be a native of Ceylon.

** Apex of the mandibulæ furnished with a rostellum; palpi and tarsi without any scopa.

Cæmentaria. *Sp.* 5. *Cæmentaria.* Rusty brown coloured; mandibules blackish, the border and carina of the thorax paler; each rostellum with five elongate nearly equal teeth.

Mygale cæmentaria, Latreille.

Mygale maconne, Walckenaer, p. 5.

Inhabits the South of France. See *Linnean Transactions,* vol. ii. pl. 17. fig. 4.

Sauvegesii. *Sp.* 6. *Sauvegesii.* Obscure-brown; each rostellum with four short unequal teeth.

Aranea Sauvagesii, Rossi (*Fauna Etruscana,* tom. ii. tab. 9. fig. 11.)

Mygale pionnière, Walckenaer, p. 5.

Mygale Sauvegesii, Latreille.

Inhabits Corsica and Italy.

B. Nails of the tarsi armed with toothed combs below.

Calpeiana. *Sp.* 7. *Calpeiana.* Brownish colour.

Mygale calpeiène, Walckenaer, p. 5.

Mygale calpeiana, Latreille.

Inhabits France.

To this division of the genus belong also *Mygale notasiana* of Walckenaer.

27. Atypus. GENUS XXVII. ATYPUS, *Latr.* OLETERA, *Walck.* ARANEA, *Ræm.*

Lip very small and quadrate, inserted under the base of the maxillæ.

Palpi inserted at the external base of the maxillæ.

Sulzeri. *Sp.* 1. *Sulzeri.* Black and shining; mandibulæ very strong; thorax nearly quadrate; plain behind, abruptly elevated before; the two middle eyes placed on an eminence; back of the abdomen leathery or coriaceous, and more shining; the juncture of the joints of the feet white.

Oletère difforme, Walckenaer, p. 7.

Atypus sulzeri, Latreille. (*Gener. Crust. et Ins.* vol. i. tab. 5. fig. 2.)

Inhabits France; has been once found in England by Mr Leach, who still has the specimen in his possession, although in a very mutilated state.* It was first described by Latreille in the *Nouveau Dictionnaire d'Hist. Nat.* tom. xxiv. table page 133. under the name *Atype,* which having the right of priority over that given by Walckenaer, we have retained.

28. Eriodon. GENUS XXVIII. ERIODON, *Latr.* MISSULENA, *Walck.*

Lip linear exserted between the maxillæ.

Palpi inserted as in the genus *Atypus.*

Occatorius. *Sp.* 1. *Occatorius.* Colour unknown.

Eriodon occatorius, Latreille.

Missulène herseuse, Walckenaer.

29 Segestria. GENUS XXIX. SEGESTRIA, *Latr. Walck.* ARANEA, *Linn. Fab. Rossi.*

Maxillæ straight, longitudinal, with the base thickened, dilated externally, somewhat wedge-shaped, the middle longitudinally convex.

Lip elongate-quadrate, longer than broad, the middle longitudinally convex, and somewhat carinated.

Feet, the first pair longest, next in order the second, then the fourth; the third pair being shortest.

Cellaria. *Sp.* 1. *Cellaria.* Brownish-black, obscurely cinereous-silky; mandibules green; the breast and base of the feet brown.

Aranea florentina, Rossi. (*Fn. Etrus.* tom. ii. p. 133. tab. 9. fig. 3.)

Segestria perfida, Walckenaer, p. 48.

Segestria cellaria, Latreille.

Inhabits fissures in old buildings and rocks, spinning a silky tube. The genitalia of the male resemble those of *Mygale avicularia.*

It is not uncommon in France and Italy; but in this country it seems to be rare, only one specimen, we believe, having been met with, which was taken by a dealer in natural curiosities in a cellar at Plymouth, and is now preserved in the collection of Mr Leach.

Senoculata. *Sp.* 2. *Senoculata.* Thorax blackish brown; abdomen oblong, grey, with a longitudinal band of black spots; feet light brown, with obscure fasciæ.

Aranea senoculata, Linn. Fabr.

Segestrie senoculee, Walckenaer, p. 48; Fourcroy.

Segestria senoculata, Latreille.

Is found in the same situations as the last species. A good figure is given in Lister's work on British spiders, p. 74. titul. 24. fig. 24. It has been bred from the egg by Mr Leach, who observed a very curious fact in the colour of this animal, viz. the bands on the feet are much more distinct in the young than in the full grown animal, so much so, indeed, that had he not known the eggs to have been deposited by this species, would probably have considered it as a very distinct species; but having an opportunity of rearing them to the full size, all doubts on the subject vanished.

30. Dysdera. GENUS XXX. DYSDERA, *Latreille, Walckenaer.* ARANEA, *Fourcroy.*

Maxillæ straight, longitudinal, with the base thickened; externally dilated at the insertion of the palpi; the apex internally obliquely truncated, and thence externally acutely terminated.

Palpi with the first joint very short and nearly obsolete.

Lip, elongate, quadrate, gradually narrowing towards the point.

Feet, first pair, then the fourth, afterwards the second, longest; the third pair shortest: a little scopula under the tarsal nails.

Erythrina. *Sp.* 1. *Erythrina.* Mandibules and thorax blood-red; the feet lighter coloured; abdomen very soft, greyish yellow, and silky.

Aranea erythrina, Fourcroy, *Fauna Parisiensis,* tom. ii. p. 224.

Drysdere éythrine, Walckenaer, p. 47.

Drysdera erythrina, Latreille, *Genera Crust. et Ins.* tom. i. tab. 5.

Inhabits France and England under stones. It is not common in this country; it has been observed by Mr Leach near Exeter and London, four or five times. *Aranea hombergii* of Scopoli (*Entomologia Carniolica,* No. 1119.) is merely a variety of this species.

Observation. To this genus, *Aranea rufipes* of Fabricius, (*Entomologia Systematica,* tom. ii. p. 426.), seem to belong, as appears from his description: "Head and thorax obscurely ferrugineous, and immaculate, eyes six, placed near together; abdomen ovate, cinereous immaculate. Feet bright red."—"Inhabits Morocco." Latreille supposes this may be even the same species with *erythrina,* as we are unacquainted with the Fa-

* Two other specimens have been since taken, one by Mr Standitch of Walworth, the other by Mr Tuther, optician, London.

Arachnides.

brician *aranea rufipes*, we cannot but hesitate on giving any thing like a decided opinion.

31. Filistata.

Genus XXXI. Filistata, *Latreille.*

Eyes placed on an uneven elevation; the four anterior ones forming a semicircle opened in front; the four hinder ones disposed in pairs in nearly the same transverse straight line.

Maxillæ much inclined towards the lip, with no sinus or groove at the insertion of the palpi.

Palpi apparently inserted on the hinder side.

Lip much longer than broad.

Feet, the fourth pair longest, and then the first pair.

Observation. This genus contains one species, *Filistata testacea* of Walckenaer's MSS. of which we have no description; it has lately been discovered in the environs of Marseilles.

32. Drassus.

Genus XXXII. Drassus, *Walck. Latr.* Aranea, *Linn.* Gnaphosa, *Latr.*

Palpi inserted under the lateral and external margin of the maxillæ towards the middle.

Maxillæ longitudinal, arcuated, gradually becoming broader from the base towards the middle, somewhat concave internally, smooth exteriorly, the middle impressed, the points bent inwards above the lip, and obliquely truncated within.

Lip elongate, ovate-quadrate, or rather oval, the base transversely truncated, enclosing the maxillæ.

Feet, the fourth, then the first, and afterwards the second pair longest.

* Lip somewhat oval; the external side of the maxillæ much bent or arched.

Melanogaster.

Sp. 1. *Melanogaster.* Mandibules blackish; thorax and feet obscure brown, thighs light reddish brown; abdomen cinereous-brown and silky.

Drassus melanogaster, Latreille.

Drasse lucifuge, Walckenaer, p. 45.

Inhabits the South of France, under stones.

** Lip ovate quadrate.

Fuscus.

Sp. 2. *Fuscus.* Obscure reddish-brown, silky, the abdomen blackish mouse coloured.

Drassus fuscus, Latreille.

Inhabits the South of France, of the same size with the other species.

Ater.

Sp. 3. *Ater.* Entirely black.

Drassus ater, Latreille.

A small species, frequently occuring in the vicinity of Paris, under stones, to which it adheres pretty firmly; when first hatched they are of a reddish colour.

Relucens.

Sp. 4. *Relucens.* Red, very smooth, like purple velvet; abdomen black, with two transverse golden yellow lines.

Drasse brillant, Walckenaer, p. 46.

Drassus relucens, Latreille.

Common in the south of France; it sometimes occurs in the neighbourhood of Paris.

33. Clotho.

Genus XXXIII. Clotho, *Walckenaer's MSS.*; *Latreille.*

Maxillæ much inclined towards the lip, with no groove at the insertion of the palpi.

Lip not much longer than broad.

Feet, fourth pair, the second, the third longest.

Eyes close together, disposed four and four in two lines bent backward in an arched and somewhat concentric manner; those in the hinder line disposed in pairs.

Observation. This genus contains but one species described in the manuscripts of Walckenaer, who communicated the generic character to Latreille, who has published it in his last work, entitled, "*Considérations générales sur l'ordre naturel des Crustacés, des Arachnides et des Insectes.*"

Durandii.

Sp. 1. *Durandii.* Thorax rusty brown, margined with pale yellow; abdomen black, with five red spots, arranged 2, 2, 1; feet livid brown.

Inhabits Montpellier, building its web amongst the stones.

Clotho durandii, Latreille.

34. Clubiona.

Genus XXXIV. Clubiona, *Latreille, Walckenaer.* Aranea, *Linné, De Geer.*

Maxillæ straight and longitudinal; the basis a little dilated externally; the apex rounded and obliquely truncated on the inside.

Lip elongate, quadrate, gradually narrowing towards the point.

Feet, the first, and then the fourth pair, (or the contrary), longest; then the second pair.

* The two outermost eyes on either side neither placed very close together, nor inserted on a distinct prominence. The maxilla in all with an incrassated base; the fourth pair of feet (rarely the first) longest.

Lapidicola.

Sp. 1. *Lapidicola.* Thorax and mandibules pale reddish; feet very light red; abdomen ash-grey coloured.

Clubione lapidicole, Walckenaer, p. 44.

Clubiona lapidicola, Latreille.

Inhabits France and Britain under stones, constructing a somewhat globular nest of the size of a common hazel nut, in the centre of which are deposited a vast number of pale yellowish eggs, agglutinated into a spherical mass.

The mandibules of the *male* porrect, and rather more than half the length of the thorax; those of the female somewhat vertical.

Tholocericea.

Sp. 2. *Tholocericea.* Mandibules blackish; thorax pale livid green; abdomen reddish-black, covered with mouse-coloured down; feet lighter than the thorax, the fourth pair longest.

Clubione soyeuse, Walckenaer, p. 42.

Clubiona holosericea, Latreille.

Aranea holosericea, Linné.

Araignée satinée, De Geer.

Inhabits Europe, getting under the bark of trees. The four anterior feet nearly of the same size.

Observation. From the position of the eyes it is probable that *Cubiona accentuata* of Walckenaer belongs to this family. From his figure, the anterior, and then the fourth pair of feet, are longest.

** The two external eyes on each side somewhat placed close together. (Maxillæ not thickened at their base; the first and then the second pair of feet longest.)

A. Maxillæ somewhat thickened at their base, and transversely impressed before the middle.

Nutrix.

Sp. 3. *Nutrix.* Ungulæ black; thorax and mandibules light red; feet very light red; abdomen yellowish green, with an obscure longitudinal band.

Clubione nourrice, Walckenaer, p. 43.

Clubiona nutrix, Latreille.

Inhabits the environs of Paris; common in a place called *Sévres*, building a nest amongst the leaves of the *Eryngium campestre.* The mandibulæ of the male stronger than those of the female.

B. Maxillæ not at all thickened at their base; front not transversely impressed.

Atrox.

Sp. 4. *Atrox.* Brown; feet pale; the tibiæ with more obscure or dark spots; the middle of the back of the abdomen with a somewhat quadrate black spot margined with yellow.

Arachnides.

Clubione atroce, Walckenaer.
Araignée atroce, De Geer.
Clubiona atron, Latreille.

Inhabits old walls and fissures of rocks. Is very common in Britain and France. A tolerable figure is given in the work of Dr Lister, in the British spiders, p. 68. fig. 21.

35. Aranea.

Genus XXXV. Aranea. *Linn. Geoff. De Geer. Fabr. Oliv. Lam.*

Maxillæ straight and longitudinal; diameters equal; anterior part convex; apex rounded, the internal angle truncated.

Lip nearly quadrate; diameters nearly equal, towards the superior angles a little narrower.

Feet, the anterior longest and nearly equal, the third shortest.

* Internal angle of the apex of the maxillæ truncated; breadth and length of the lip nearly the same; the feet of a moderate length.

Obs. The series of eyes, especially the lower, more arched in this than in the second division of the genus.

Genus Agelena of Walckenaer.

Labyrinthica.

Sp. 1. *Labyrinthica.* Pale grey, inclining to red; the thorax on each side with a longitudinal black line; abdomen black, above and on each side with oblique white lines, meeting together by pairs at obtuse angles in front; the spinning papillæ conic and lengthened.

Aranea labyrinthica. Linné, Fabricius, Latreille.
Agelena labyrinthica. Walckenaer.
Agelène labyrinthe. Walckenaer, page 51.

Inhabits Europe; is very abundant in summer, more so in autumn: it spins a horizontal web in the ground, in which it watches for its prey, which consist principally of flies and other dipterous insects; the spider itself living in a funnel-shaped cavity, often extending below the surface of the ground. There are good figures in the works of Lister (page 60. fig. 18.) and in Schæffer's *Icones Insectorum,* (tab. 221. fig. 12.; tab. 19. fig. 8.)

** Internal angle of the maxillæ at the apex evidently truncated. Lip longer than broad. Feet elongated.

Genus Tegeneria of Walckenaer.

Domestica.

Sp. 2. *Domestica.* Livid grey; the thorax of the male immaculate; of the female with a longitudinal blackish line on each side; abdomen blackish, the dorsum in the middle with a longitudinal fascia or band, spotted, toothed with two lateral livid lines.

Aranea domestica. Linné, Fabricius, Latreille.
Araignée domestique. De Geer, Latreille.
Tegeneria domestica. Walckenaer.
Tégénaire domestique. Walckenaer, page 49.

Inhabits the houses of Europe; spinning its web in a place where there is a cavity, such as the corner of a room, that she may have a free passage, on each side, to make her escape in case of danger. Her mode of constructing her web is curious: having chosen a convenient spot, she fixes one end of her thread to the wall, and passes on to the other side, dragging the thread along with her, (or rather the thread follows her as she proceeds,) till she arrives at the other side, and there fixes the other end of it. Thus she passes and repasses, till she has made as many parallel threads as she thinks necessary for the purpose. After this she begins again, and crosses these by other parallel threads. These are the toils or snares which she prepares for entangling flies and other small insects. Besides this large web, she weaves a cell for herself, where she lies concealed, watching her prey. Between this cell and the net she has a bridge of threads, which, by communicating with the threads of the large one, both gives her intelligence when any thing touches the web, and enables her to pass quickly in order to lay hold of it.

36. Argyroneta.

Genus XXXVI. Argyroneta, *Latreille, Walck.* Aranea, *Linn. Geoff. Fabr.*

Maxillæ short, straight, and elongate-quadrate, the side of nearly equal diameters; face convex before, apex rounded.

Lip short; shorter than the maxillæ, of a narrow elongate-triangular or (somewhat conic) form; the anterior aspect convex, the apex either obtuse or truncated.

Feet, the first, the fourth, and lastly the second pair longest.

Obs. The sexual distinctions are the same in this genus as in the Clubionæ.

Aquatica.

Sp. 1. *Aquatica.* Blackish-brown; the abdomen black and velvety, impressed with dorsal punctures.

Aranea aquatica. Linné, Fabricius.
Argyronéte aquatique. Walckenaer.
Argyroneta aquatica. Latreille.
Araignée aquatique. De Geer.

Inhabits fresh waters, that flow slowly, throughout Europe. It resides in a web most beautifully constructed under the water, in which it lives, being surrounded by air, which shines through the water with a silvery lustre. The eggs are deposited in a globose silky bag. In Britain it appears to be of very rare occurrence, only having been taken once, if we recollect rightly, near Hornsey. This specimen is preserved in the collection of our great and illustrious zoologist, Edward Donovan, Esq.

37. Scytodes.

Genus XXXVII. Scytodes. *Latreille, Walckenaer.*

Maxillæ oblique and longitudinal, covering the sides of the lip; the base thickened, the apex internally obliquely truncated.

Lip somewhat quadrate, the base a little contracted.

Feet, the fourth, then the first, lastly the second pair longest.

Thoracica.

Sp. 1. *Thoracica.* Pale reddish white, spotted with black; thorax large and somewhat orbicular, elevated roundly behind; abdomen lighter coloured, and somewhat globose.

Scytode thoracique. Walckenaer, page 79.
Scytodes thoracica. Latreille.

Inhabits houses in Paris. Is figured in the *Genera Crustaceorum et Insectorum* of Latreille, (tab. 5. fig. 4.)

38. Theridion.

Genus XXXVIII. Theridion, *Latreille.* Aranea, *Linn. Geoff. Fabr.*

Maxillæ with an oblique direction, covering the sides of the lip, converging towards the apex, from the insertion of the palpi to the apex of an equal breadth and plain, the internal apex either obliquely truncated or obtuse.

Lip small, triangular or semicircular, the apex truncated, or somewhat rounded, or somewhat square.

Feet elongate, very slender; the first, then the fourth, then the hinder ones longer.

* Two of the eyes close together on each side.

Genus Theridion of Walckenaer.

Rufum.

Sp. 1. *Rufum.* Abdomen globose, the upper part radiated with white lines

Théridion Sisiphe. Walckenaer.

Arachnides.

Theridion Sisiphum. Latreille.

Inhabits Europe, nidificating under the prominences of pillars, or projections of walls.

Redimitum. *Sp.* 2. *Redimitum.* Yellowish white; abdomen oval, with a rose-coloured dorsal ring.

Aranea redimita. Linné.

Theridion couronné. Walckenaer.

Theridion redimitum. Latreille.

Inhabits plants. Abdomen often spotted. Latreille supposes *Theridion ovatum* of Walckenaer to be no more than a variety of this species; and that the *l'araignée à bande rouge* of Geoffray, (*Hist. des Insect.* tom. ii. page 648) is referable to the same variety.

** The two lateral eyes at a distance from each other.

Genus LATRODECTUS of Walckenaer.

Obs. Walckenaer has examined the eyes, maxillæ, and lip of the THERIDIONA, with the most minute attention. In his last work, Latreille has admitted the genus LATRODECTUS as distinct from THERIDION, and given the following characters; but as we are not acquainted with the genus LATRODECTUS, the reader must judge for himself.

LATRODECTUS. The first and then the second pair of feet longest; eyes disposed, four and four, in two transverse straight parallel lines.

THERIDION. The first and then the fourth pair of feet longest; the four middle eyes disposed in a square, the lower ones situated on a common prominence; two others close together, and placed in an eminence on each side.

From the above characters it would seem they are very distinct genera, but a letter on the subject we have received from a friend, informs us that he is well acquainted with the animal's economy, and that it ought to remain where Latreille placed it, in the first instance, at least for the present, as our knowledge of the subject is at present too limited for us to make two minute divisions; on this ground, therefore, we continue it under the generic title of THERIDION.

Tredium-guttatum. *Sp.* 3. *Tredium-guttatum.* Black; abdomen globose, with thirteen blood-red spots.

Aranea 13-guttata of Rossi and Fabricius.

Latrodecte malmignatte. Walckenaer, page 81.

Theridion 13-guttatum. Latreille (*Gen. Crust. et Ins.* i. p. 98.

Latrodectus 13-guttatus. Latreille. (*Consid. Ord. Nat.* &c.)

Inhabits Italy, and is common in the plains of that country.

39. Pholcus. GENUS XXXIX. PHOLCUS, *Walck. Latr.* ARANEA, *Geoff. Scopoli.*

Maxillæ oblique, covering the sides of the lip, converging from the base to the apex; apex internally truncated.

Lip transversely quadrate, the lateral angles at the apex rounded and somewhat marginated.

Feet very long and slender, the first longest, then the second, and then the fourth nearly equal.

Phalangioides. *Sp.* 1. *Phalangioides.* Pale livid; abdomen elongate; very soft, of a cylindrical oval form, and obscure grey colour; the apex of the tibiæ and thighs with a whitish, pale anulus or ring.

Pholcus phalangiste. Walckenaer, page 80.

Aranea pluchii. Scopoli.

Aranea phalangioides. Fourcroy. (*Entomologia Paris,* ii. 213.)

Pholcus phalangioides. Latreille.

Inhabits the European houses; its body vibrates after the manner of TIPULARIÆ, or *gnats.* Is very common in the west of England.

GENUS XL. ULOBORUS. Latreille. 40. Uloborus.

Eyes eight, equal and very minute, placed in two transverse lines, the first nearly straight, and scarcely bent backwards; the two middle ones a little nearer than the others; the posterior line bent forwards.

Maxillæ straight, broad, inversely triagonal, the side broader than the apex.

Lip very small and semicircular.

Feet, first pair much the largest, then the fourth, and afterwards the second.

Sp. 1. *Walckenaerius.* Pale reddish yellow; thorax and abdomen silky; the back white; abdomen oblong, banded with fasciculi of hairs; feet also banded with darker rings. Walckenaerius.

Inhabits the pines in Germany and France, where it constructs a web like that of *Lyniphya triangularis.*

GENUS XLI. TETRAGNATHA, *Latr. Walck.* ARANEA. *Linn. Fab. Oliv.* 41. Tetragnatha.

Maxillæ straight, elongate and narrow; almost as broad as long; the apex externally dilated and rounded.

Lip semicircular and somewhat notched.

Feet very long and very slender; the first pair, then the second, and then the fourth longest.

Sp. 1. *Extensa.* Reddish; abdomen oblong, golden green, with the sides and two lines below yellowish; the middle below longitudinally black. Extensa.

Aranea extensa. Linné, Fabricius.

Tetragnathe etendue, Walckenaer, p. 68.

Tétragnatha extensa. Latreille.

Inhabits moist places in Europe; it spins a vertical web, and remains with its feet extended, the anterior ones porrected.

GENUS XLII. ZINYPHIA, *Latr. Walck.* ARANEA, *Linn. De Geer.* 42. Zinyphia.

Maxillæ nearly straight, inversely—somewhat oval.

Lip semicircular.

Feet elongate and slender; the first, then the second, afterwards the fourth pair longest.

Sp. 1. *Triangularis.* Pale reddish, inclining to yellow; thorax with a black dorsal line, bifid in front; abdomen oval, inclining to globose, with spots and angulated bands of brown and white; feet immaculate. Triangularis.

Linyphie triangulaire. Walck. page 70.

Linyphia triangularis. Latreille.

Inhabits the European hedges; is common in Autumn, building its nest on pines, ferns, and genistæ.

GENUS XLIII. EPEIRA, *Walck. Latr.* ARANEA, *Linn. Fab. Lam. Donovan.* 43. Epeira.

Maxillæ nearly straight, their base narrow, their apex widened; the base internally concave; the apex above the lip incurved, and obliquely truncated.

Lip semicircular, and somewhat margined.

Feet elongate and slender; the first pair longest, then the second, afterwards the fourth; the third very short.

* *Thorax* an oblong oval, inclining to quadrate; the lateral *eyes* placed on a tubercle; *abdomen* coriaceous, and spinous above; or soft, much lengthened and cylindrical, and rounded at the base and apex.

A. Abdomen coriaceous or spiny above; the anus below prominent and tubular.

a. Abdomen nearly triangular, extended in length.

Arachnides.

Armata. *Sp.* 1. *Armata.* Abdomen depressed and punctate, with four spines; the two lateral ones very short; the others very long and crooked.

Aranea taurus, Fabricius. *Epëira armata*, Latr.
Inhabits the island St Domingo.

Aculeata. *Sp.* 2. *Aculeata.* Black; abdomen with eight spines; six on the back; two very small, and horizontal at the base; three on each side, marginal and erect; the hinder two large and red, with blackish points, with two inferior ones at their base; thighs rough with spines.

Epëira armée, Walck. p. 65. *Aranea aculeata*, Fabr.
Inhabits Cayenne.

b. Abdomen extended in breadth.

Cancriformis. *Sp.* 3. *Cancriformis.* Abdomen transversely oval and depressed; the superior margin (or ambitus) with six teeth; the teeth equal, two on each side, and two behind.

Aranea cancriformis, Linné, Fabricius. *Epëira cancriformis*, Latreille.

Inhabits the American islands. A good figure may be found in Brown's *Hist. of Jamaica*, p. 419, pl. 44, fig. 5.

B. Abdomen soft, without spines; generally elongated, and somewhat cylindrical, rounded at the base and apex; thorax with two dorsal tubercles. The tibia, the third excepted, generally covered with tufts of hair.

Clavipes. *Sp.* 4. *Clavipes.* Thorax black, covered with silver-coloured silky down, on which are black spots; abdomen obscurely yellowish, with white spots; the mouth, the greater part of the breast, and feet, pale-reddish. All the tibiæ, except the third pair, with tufts of hair.

Aranea clavipes, Linné, Fabr. *Epëira clavipes*, Latr.
Inhabits South America.

** *Thorax* somewhat heart-shaped, not half as long again as broad; the anterior margin much narrower than the greatest breadth.

A. Anterior part of the thorax depressed and flat; the sides abruptly sloping at nearly right angles.

a. The lateral eyes somewhat geminated; the anterior margin of the thorax at least half the breadth of the broadest part.

Sexcuspidata. *Sp.* 5. *Sexcuspidata.* Brown; thorax with six tubercles placed in a double transverse series; the three anterior ones bearing eyes; palpi, tibiæ, and tarsi, compressed.

Aranea sexcuspidata, Fabr. *Epëire impériale*, Walck. p. 67. *Epëira sexcuspidata*, Latreille.
Inhabits the Cape of Good Hope.

Umbratica. *Sp.* 6. *Umbratica.* The mandibules, hinder part of the thorax, under part of the body, and greater part of the thighs, black; anterior part of the thorax, with the tibiæ and tarsi, greyish-red; the tibiæ annulated with black; abdomen depressed, triangular oval, obscurely reddish-grey, with six or eight cicatrized black dorsal spots, placed in a double longitudinal series, with two undulating lines marginated with pale, one on each side, conjoining behind.

Aranea umbratica, Villers. *Epëire ombraticole*, Walck. p. 61. *Epëira umbraticola*, Latreille.

Inhabits Europe, being most frequently found in shady groves. The base of the mandibules elevated; the interior margin of the thorax broader than in the other species of this subdivision.

Diadema. *Sp.* 7. *Diadema.* Reddish; abdomen globosely, oval, the base on each side with an elevated angle; the back with a broad, dentated, triangular, obscure mark, and a triple cross formed of yellowish white spots; the four middle ones impressed and disposed in a quadrangle.

Aranea diadema, Linné, Fabricius, Donovan, Shaw. *Epeire diadème*, Walck. p. 58. *Epeira diadema*, Latr.
Inhabits Europe; is very common in gardens.

b. The lateral *eyes* somewhat geminated. The anterior margin of the *thorax* about a third part of the breadth of the broadest part.

1. Sides of the abdomen entire.

Fasciata. *Sp.* 8. *Fasciata.* Thorax and base of the abdomen above silvery; abdomen ovate, with yellow bands and black transverse lines.

Aranea fasciata, Fabr. *Aranea formosa*, Villers. *Aranea phragmitis*, Rossi. *Epeire fasciée*, Walck. p. 55. *Epeira faciata*, Latr.

Inhabits the south of Europe; is found in France, Italy, Sweden, and has been received from Madeira, where it was first observed by a lady of eminent abilities.

2. Sides of the abdomen notched.

Sericea. *Sp.* 9. *Sericea.* Body silvery; feet reddish, annulated with black and red.

Epèire soyeuse, Walck. p. 56. *Epèira sericea*, Latr.
Inhabits the south of France and Africa.

B. Anterior part of the thorax convex; the sides gradually sloping away.

a. The distance between the lateral and four middle eyes, much greater than the breadth of the quadrangle, formed by these four eyes.

Cucurbitina. *Sp.* 10. *Cucurbitina.* Abdomen globose, of a yellow green colour, somewhat spotted with black; a red spot behind.

Aranea cucurbitina, Linné. *Epèire cucurbitine*, Walck. *Epeira cucurbitina*, Latr.
Inhabits plants in Europe.

b. The distance from the lateral to the four middle eyes about the same as the breadth of the quadrangle formed by the four middle eyes.

Calophylla. *Sp.* 11. *Calophylla.* Thorax and feet pale livid yellow; the mandibules a triagonal spot on the anterior part of the thorax, and spots on the feet blackish; abdomen globose-oval cinereous-grey; back with four impressed spots; and a large silvery-grey oval spot, truncated behind, sinuated laterally, with the margins and a spot on each side in front of the abdomen, with a double line on the breast, and a longitudinal band in the middle of the belly black; sides of the breast with a yellow line.

Epèire calophylle, Walck. p. 62. *Epeira calophylla*, Latr.
Inhabits the eaves of houses; is common in Paris.

Menardi. *Sp.* 12. *Menardi.* Livid reddish; hinder part of the thorax deeply impressed with a dorsal line, bifid before, of a brown colour; abdomen globosely oval, of a darker colour; the back, the middle of the belly, and two lines on each side, light yellow; the dorsal space intersected behind by transverse bands anteriorly, with two oblong blackish spots; feet with dark rings.

Epèire brun, Walckenaer. *Epeira menardi*, Latr.

Conica. *Sp.* 13. *Conica.* The lateral and inferior middle eyes resting on a common tubercle; thorax black; abdomen ovate, of a reddish grey colour, with spots and reticulated black lines, the hinder part above and below protruded into a conic process; feet pale yellow, knees reddish.

Epèire conique, Walck. *Epeira conica*, Latr. *Araignée à ventre conique*, De Geer.

Inhabits the European woods; is common in Britain.

45. Episinus. GENUS XLV. EPISINUS, *Walckenaer's MSS. Latr.*

Maxillæ straight and longitudinal, the base a little dilated, the apex rounded.

Lip much broader than long, and semicircular.

Feet much lengthened; the anterior and then the fourth pair longest; the third shorter.

Eyes forming the segment of a circle, of nearly an equal size, placed on an eminence.

Observation. We have introduced this genus on the authority of Latreille, who copied his character from the

Arachnides. manuscripts of his friend Walckenaer; it contains but one species, *Episenus truncatus*.

Truncatus. *Sp.* 1. *Truncatus.* Thorax cordiform, a little longer than broad, anteriorly acute, little, above of an obscure reddish brown; the breast reddish brown; the abdomen brown, pyramidal, marginated in front; the dorsal area three-sided, with the hinder angles produced; the third pair of feet white, the others brown; the apex of the first and fourth, and base of the latter, white.

46. Micrommata. GENUS XLVI. MICROMMATA, *Latreille*. ARANEA, *De Geer, Fabr.* SPARASSUS, *Walckenaer*.

Maxillæ straight, oval inclining to square, with a longitudinal angle on their inside; the internal edge at the base somewhat concave; the apex obliquely truncated.

Lip short and semicircular.

Feet elongate; the fourth longest, the second rather shorter; then the first, afterwards the third. Lower part of the apex of the tarsi furnished with a little double brush.

Smaragdina. *Sp.* 1. *Smaragdina.* Bright green; dorsum of the abdomen with a longitudinal band of a darker colour.

Aranea smaragdula, Fabr. *Araignée toute-verte*, De Geer. *Sparasse émerandine*, Walck. p. 39. *Micrommata smaragdina*, Latr.

Inhabits the European woods and groves. The male has three longitudinal red lines on its back.

Observation. The genus was first established by Latreille under the name *Micrommate*, in the *Nouv. Diction. d'Hist. Natur.* tom. 24. p. 135. in which work also a figure is given; on this account we have retained it, and have consequently rejected the term *Sparassus* of Walckenaer, Latreille's name having the right of priority.

47. Thomisus. GENUS XLVII. THOMISUS, *Walck. Latr.* ARANEA, *Lin. Fab. De Geer.*

Maxillæ oblique, covering the sides of the lip, and in some degree converging; the internal apex truncated.

Lip somewhat oval, or nearly quadrate, generally longer than broad.

Feet, the first and second pair longest; the latter rather longer than former or scarcely shorter; the third and fourth generally much less; sometimes one longer, sometimes the other.

Observation. The mandibulæ are either perpendicular or somewhat inflexed, in many conical, with very short nails. Latreille formerly included this genus under the titles *Heteropoda* and *Misumena*.

** Thorax convex and heart-shaped; the sides, especially behind, abruptly sloping, anteriorly broadly truncated; the largest feet not double the length of the body; the first and second pair of the same magnitude as the rest, but far exceeding them in thickness (sometimes one sometimes the other longer.) The first joint of the tarsi with several moveable little spines, in a single or double series; the nails of all the tarsi naked. Lip somewhat oval, the apex either truncated or obtuse: The apex of the maxillæ somewhat wedge-shaped.

Citreus. *Sp.* 1. *Citreus.* Thorax, at the insertion of the eyes, transversely elevated, the sides anteriorly produced and prominent; eyes equal; abdomen roundish-triagonal, broader behind, with a red line on each side; body yellowish-citron coloured.

Thomise citron, Walck. p. 21. *Thomisus citrinus*, Latr.

Inhabits flowers in Europe. Is common in Britain.

The male is much smaller than the female, of a brown colour, banded with yellowish-green.

Cristatus. *Sp.* 2. *Cristatus.* Lateral eyes placed in a tubercle, the lower ones largest; body pale grey, inclining to reddish; the back of the thorax on each side with a spot, and margins whitish; abdomen somewhat orbiculate, the circumference obscurely brown, with a pale, broad, dorsal band with its side notched.

Thomisus cristatus, Walck. p 32. *Thomisus crist.* Latr.

Inhabits gardens and fields; is very common about Paris. Thoracic spot pale, often bifid in front. Abdomen with five impressed dorsal marks; the anterior one largest, the other four disposed in a quadrangle.

Latreille thinks *Aranea liturata* of Fabricius is near akin to this species.

** Thorax convex heart-shaped, the sides, especially behind, abruptly sloping, the anterior part broadly truncated; the larger feet not twice the length of the body; all of nearly an equal degree of thickness; the hinder four not much shorter; the anterior with four little spines; the nails of all the tarsi scarcely visible. The maxillæ and labium as in the preceding division.

Sp. 3. *Lynceus.* Lateral eyes largest, placed on a tubercle; the tubercles of the hinder ones thickest; body pale yellowish-grey, variegated with punctures and spots of a blackish colour; abdomen very large, of a triangular-oval form, broader behind. Lynceus.

Inhabits France and Scotland.

Thomisus lynceus of Latreille, who considers it much akin to *Thomisus onustus* of Walckenaer, p. 32.

*** Thorax depressed, and somewhat oval, and very obtuse before; the larger feet not twice the length of the body; all of an equal thickness; the tarsi below hairy; the first joint with a few little spines; the apex with two brushes under the nails; abdomen oblong; the maxillæ, beyond the insertion of the palpi, nearly of an equal breadth, distinctly and abruptly truncated; lip somewhat quadrate; hinder lateral eyes distant.

Observation. This divison is near the genus *micrommata* of Latreille's former works.

Sp. 4. *Oblongus.* Pale yellowish, above with white hairs, the abdomen somewhat cylindrical, with the longitudinal obscure lines. Oblongus.

Thomise oblonge, Walck. p. 38. *Thomisus oblongus*, Latr.

Inhabits France and Denmark on plants.

**** Thorax depressed and heart-shaped, truncated before; the four anterior feet more than double the length of the body; the under part of the tarsi in most of the species hairy, in all furnished with two brushes under the nails; the maxillæ short, much inflexed above the lip, nearly of an equal breadth beyond the insertion of the palpi; apex abruptly truncated; lip nearly quadrate, broad; the second pair of feet longest.

A. Eyes arranged in two nearly parallel lines; tarsi hairy beneath; the 3d pair of feet shorter than the 4th.

Sp. 5. *Leucosia.* The four lateral eyes largest; body of a pale dirty yellow, inclining to red; thorax with the anterior margin and a posterior band yellowish-grey; the hinder band margined with black above. Leucosia.

Aranea regia, Fabr. *Thomise leucosie*, Walck. p. 36. *Thomisus leucosia*, Latr.

Inhabits Tranquebar and the Isle of France.

Large; the mandibules obscure red with black ungules; an obsolete blackish spot at the base of the tibiæ; the hairs of the feet spiniform, the hairyness of the tarsi black; the eyes of the anterior line approaching one another in pairs.

Sp. 6. *Lamarckii.* The eyes of the front line largest, and nearly of equal size; body ash-grey; mandibules blackish; breast, middle of the venter, base of the abdomen above, with bands on the feet black. Lamarckii.

Aranea nobilis? Fabr. *Thomisus Lamarck*, Latr.

Inhabits the Isle of France. Was named by La-

Arachnides.

treille, in honour of the celebrated zoologist, Lamarck, who first instituted the ARACHNIDES as a distinct class.

B. Eyes disposed in a semicircle; the under part of the tarsi scarcely hairy; the third pair of feet longer than the fourth.

Venatorius. *Sp.* 7. *Venatorius.* Yellowish-red; abdomen yellow-grey, clouded with ash-grey; feet spotted with black.

Aranea venatoria, Linné. *Aranea pallens?* Fabr. *Thomisus venatorius,* Latr.

Inhabits the American islands.

C. Eyes disposed in a circle; tarsi scarcely hairy beneath; third pair of feet longer than the fourth.

Levipes. *Sp.* 8. *Levipes.* Body grey, spotted with black; abdomen plain, rhomboidal.

Aranea levipes, Linné, Fabr. *Thomise tigré,* Walck. p. 34. *Thomisus tigrinus,* Latr. *T. levipes,* Leach's MSS.

Inhabits the European trees, running swiftly.

48. Oxyopes. GENUS XLVIII. OXYOPES, Latr. SPHASUS, Walck.

Maxillæ straight, longitudinal, and elongate, of an equal breadth nearly from base to apex; apex externally gradually arcuated or bent, internally obliquely truncated. Lip oblong-quadrate.

Feet long and slender, the first pair longest, then the fourth and second, which are nearly equal; tarsi short; nails exserted, no brush beneath.

Variegatus. *Sp.* 1. *Variegatus.* Body hairy and grey, variegated with red and black; feet pale reddish, spotted with brown; the little spines on the tibiæ lengthened.

Sphase hétérophthalme, Walck. p. 19. *Oxyopes variegatus,* Latr.

Inhabits France. The bag containing the eggs round, depressed, and white.

Lineatus. *Sp.* 2. *Lineatus.* Mandibules, thorax, and feet, pale reddish-yellow; mandibules with a line; thorax with three longitudinal fasciæ of a brown colour; abdomen obscurely brown, with longitudinal pale reddish-yellowish lines; the dorsal line branched or forked before.

Oxyopes lineatus, Latreille, (*Genera Crust. et Insect.* vol. i. plate 5, fig. 5.) Inhabits France.

49. Storena. GENUS XLIX. STORENA, Walckenaer's MSS. Latr.

Eyes forming a nearly equal hexagon, disposed in three transverse lines thus, 2, 4, 2.

Maxillæ much longer than the lip, which they cover. Lip oval and lengthened.

Observation. Of the species in this and the following genus we can say nothing, as the genera are unknown to us, and Latreille has not even hinted at the name of a species; notwithstanding this, we conceived the genera ought to be introduced, as it is not improbable that some British species will be found referable to one or other of them.

50. Ctenus. GENUS L. CTENUS, Walckenaer's MSS. Latreille.

Eyes forming an elongate curved angulated line, very open behind, disposed in three transverse lines thus, 2, 4, 2.

Maxillæ longer than the lip. Lip quadrate.

51. Lycosa. GENUS LI. LYCOSA, Latreille, Walckenaer; ARANEA, Linné, Fabricius, Lamarck, Olivier.

Maxillæ straight, anteriorly convex, externally towards the side somewhat arcuated, internally slightly marginated, gradually narrowing towards the base; apex obliquely truncated, almost an inverted triangle.

Lip elongate, quadrate.

Feet strong; the fourth, then the first, after these the second, longest, the third short.

Tarentula. *Sp.* 1. *Tarentula.* Upper part of the body greyish-brown; mandibules and middle of the palpi ferrugineous, the apex of the latter black; thorax with a grey margin, and radiated dorsal line of the same colour; anterior part of the dorsum of the abdomen with triagonal spots, hinder part with bent, transverse, black strigæ, margined with white; belly of a fine crocus yellow, with a transverse black band; thighs and tibiæ below reddish-white, with two black spots.

Aranea tarentula, Linné, Fabr. *Lycose tarentule,* Walck. p. 11. *Lycosa tarentula,* Latr.

Inhabits the South of Europe.

Observations. Lycosa tarentula Narbonensis of Walckenaer, is much smaller than the preceding species; and the belly is black, with a crocus-coloured anus.

Sp. 2. *Ruricola,* greenish-livid-brown, with the margins and abbreviated dorsal line at the base of the abdomen, with the ridge of the thorax and feet pale brown, inclining to livid; the back of the abdomen on each side with a double parallel longitudinal series of fine, small, livid-brown spots. Ruricola.

Lycose agrétique, Walck. *Lycosa ruricola,* Latr.

Inhabits France and Britain, is common early in spring, occurring in marshes and thick woods.

Sp. 3. *Saccata.* Body above, smoke-coloured, inclining to black, clouded with ash-coloured hairs; the ridge of the thorax obscure reddish, with an ash-grey line; the base of the back of the abdomen with a little tuft of hairs; feet livid red, intersected with blackish marks. Saccata.

Aranea Lyonetti, Scopoli. *Lycose à sac,* Walck. *L'araignée Loup,* Geoffroy. *Lycosa Saccata,* Latr.

Inhabits European gardens and cultivated grounds; is very common. The female carries her bag of eggs about with her, the external covering of which is generally a bluish-green, or greenish-blue. The palpi, mandibulæ, and front of the thorax, livid red in the female, black in the male.

Sp. 4. *Velox.* Feet grey-reddish, annulated with black; belly and anus ash-grey; a large red spot at the base of the abdomen, mixed with grey, of a spear shape; middle of the back with a black transverse band, with two spots, and an intermediate splatch of grey. Velox.

Lycosa velox, Walck. *Aranea perita* (*Bullet. de la Soc. Philom. No.* 22.)

GEN. LII. DOLOMEDES, Latreille, Walck.—ARANEA, Linn. De Geer. Fabr. 52. Dolomedes.

Maxillæ straight, oval-quadrate, the apex externally rounded, internally obliquely truncated.

Lip somewhat square, the diameters nearly equal, the points of the angles rounded.

Feet elongate, the fourth longest, then the second, and afterwards the first. The nails of the tarsi exserted, with no brushes below.

Sp. 1. *Mirabilis.* Pale-reddish, covered with greyish down; thorax heart-shaped, anteriorly abruptly sloping; with the anterior angles and dorsal line whitish; abdomen conical, inclining to oval, back darker. Mirabilis.

Aranea saccata? Linné? *Aranea obscura,* Fabr. *Aranea sisteri,* Scopoli. *Dolomède admirable,* Walck. p. 16. *Dolomedes mirabilis,* Latr.

Inhabits Europe, residing in woods. The female is often to be seen carrying about her bag of eggs, the covering or bag being of a greyish dirty yellow colour.

Sp. 2. *Marginatus.* Thorax and upper part of the abdomen obscure brown, the sides margined with white; thorax oval, truncated before; abdomen oval; feet green. Marginatus.

Dolomède bordé, Walck. *Dolomedes marginatus,* Latr.

Inhabits most woods and marshes in France, Germany, Sweden, and England.

II. Feet formed for leaping. Thorax not carinated.

GEN. LIII. ERESUS, Walck. Latr.—ARANEA, Villers. Rossi. Olivier. 53. Eresus.

Maxillæ straight, longitudinal, and somewhat wedge-shaped; the apex broader, rounded externally, internally obliquely truncated.

Arachnides.

Lip nearly an equal sided triangle, the margins somewhat bent back on the point.

Feet strong and short; the fourth, the first, then the second, longest; the third rather shorter than the second pair.

Cinneberinus. *Sp.* 1. *Cinneberinus.* Black; abdomen cinnabar-red above, with four or six black spots, disposed in a double longitudinal line; joints of the feet white; the hinder sides of the thorax, the thighs, with the first joint of the tibiæ of the four posterior feet, pale red.

Aranea moniligera, Villers. *Aranea 4-guttata,* Rossi. *Eresus cinnaberinus,* Latreille, Walckenaer, p. 21.

Inhabits France, Italy, and Germany.

54. Salticus. Gen. LIV. Salticus, Latr.—Aranea, Linn. Fab. Oliv.—Attus, Walck.

Maxillæ straight, longitudinal, and of a somewhat rhomboidal or inverse wedge-shaped oval.

Lip elongate, somewhat oval, apex obtuse.

Feet generally strong, especially the anterior pair, which are short, and formed for leaping; the fourth and first longest, and nearly equal; then the second and third, which are nearly equal in size also.

* Feet thick and short; palpi clubbed; thorax truncate-oval, or parallelogrammic.

Scenicus. *Sp.* 1. *Scenicus.* Black; circumference of the thorax with a white hairy margin; abdomen short, oval, upper part with a greyish-red down, and three transverse undulating bands, and the anus white; the first, or that band nearest the base, unbroken, the others interrupted in the middle.

Aranea scenica, Linné, Fabr. *Salticus Scenicus,* Latr. *Atte Paré,* Walckenaer.

Inhabits walls and palings; is found in most parts of Europe; the female has her palpi white; feet covered with reddish-grey down, and obscure spots. Mandibules of the male very large.

Sanguinolentus. *Sp.* 2. *Sanguinolentus.* Black; the margins of the thorax with a white villose line; abdomen small, somewhat oval, blood-red, with a lanceolate black mark on the middle of the back; the four anterior tibiæ bright yellow.

Aranea sloanii, Scopoli, Rossi. *Aranea sanguinolenta,* Linné, Fabr. *Atte sanguinolente,* Walck. p. 24. *Salticus sloanii,* Latr. *Salticus sanguinolentus,* Leach's MSS.

Inhabits the S. of Europe, seen only once in Britain.

Rumphii. *Sp.* 3. *Rumphii.* Black; variegated with grey and brown; the anterior margin of the thorax with pale reddish down; abdomen elliptical, with an uneven, broad, longitudinal grey band, margined with black.

Aranea rumphii, Scopoli. *Atte tardigrade,* Walck. p. 25. *Salticus rumphii,* Latreille.

Inhabits France, is often taken in the environs of Paris on the trunks of willows.

** Feet long and slender; palpi filiform; thorax long, narrow, and somewhat conic.

Formicarius. *Sp.* 4. *Formicarius.* Thorax black before, red behind; abdomen brown, with a white spot on each side; feet red.

Atte fourmi, Walck. *Salticus formicarius,* Latr.

Inhabits plants and walls throughout Europe, is very rare in Scotland.

Family X. Tarantulides.

55. Tarantula. Genus LV. Tarantula, Brown, Fabricius.—Phalangium, Linné, Pallas.—Phrynus, Olivier, Lamarck, Hermann, Latreille, Herbst.

Palpi long, terminated by a horny, crooked, moveable nail.

Maxillæ obverse-conic, diverging internal angle at the apex lengthened, compressed and rounded.

Body short and depressed; thorax either kidney-shaped or lunulated; no tail.

Eyes eight; two on the middle of the anterior margin, in a transverse line; three on each side, disposed in a triangle.

Lunata. *Sp.* 1. *Lunata.* Palpi nearly three times as long as the body; the apex of the third joint alone spiny; spines four in number, the two upper ones strongest.

Phalangium reniforme, Linné. *Phalangium lunatum,* Pallas. *Tarantula lunata,* Fabr. *Phrynus lunatus,* Latr.

Inhabits the East Indies.

Media. *Sp.* 2. *Media.* Palpi nearly six times as long as the body; the inside spiny from one end to the other; the spines at the point very numerous.

Phrynus medius. Herbst. Inhabits South America?

Reniformis. *Sp.* 3. *Reniformis.* Palpi length of the body, the second and third joints compressed, and spiny on the inside; the last joint internally dilated, and armed with five or six strong spines.

Phalangium reniformis, Pallas. *Cancellus aranoides,* Petiver. *Tarantula reniformis,* Fabr. *Phrynus reniformis,* Latreille.

Inhabits South America; is common in Jamaica, St Domingo, and other islands.

56. Thelyphronus. Genus LVI. Thelyphronus, Latreille. Phalangium, Linn. Pall. Tarantula, Fabricius.

Palpi short and thick, terminated by a forceps, or finger and thumb.

Maxillæ nearly triangular, and large, meeting within.

Body elongate, and cylindrical; thorax oval; abdomen terminated by a tail.

Eyes as in the preceding genus.

Proscorpio. *Sp.* 1. *Proscorpio.* Palpi spinous or branched.

Phalangium caudatum, Linné, Pallas? *Tarantula caudata,* Fabricius? *Thelyphronus proscorpio,* Latr.

Family II. Scorpionides.

57. Scorpio. Genus LVII. Scorpio, Linn. Fabr. Oliv. Latr. Lam. Herbst, Shaw, Donovan.

Maxillæ short, rounded, internally somewhat arched and hairy.

Lip with four triangular porrect pieces or valves, the two external ones joined to the anterior, the two internal ones to the base of the second pair of feet.

Eyes six or eight.

Body elongate; with two pectinated laminæ (which are denominated pecten) at the under base of the abdomen.

Tail composed of six joints, the last sharp or aculeated; the sting bent, instilling poison into the wound it makes.

* Eyes eight in number.

Occitanus. *Sp.* 1. *Occitanus.* Pectens with twenty-eight teeth; body yellowish; tail longer than the body, with elevated granulated lines, with no prominence under the sting.

Scorpio occitanus, Amoreux, (*Jour. de Phys.* 1789.) Latr. *Scorpio tanetanus,* Redi.

Inhabits the southern parts of Europe.

Afer. *Sp.* 2. *Afer.* Pectens with thirteen teeth; hands somewhat heart-shaped, hairy, and slightly granulated.

Scorpio afer, Linn. Fabricius.

Inhabits India.

Americanus. *Sp.* 3. *Americanus.* Pectens with fourteen teeth; hands somewhat ciliated; fingers filiform.

Scorpio Americanus. Linné, Fabricius.

Inhabits America.

Australis. *Sp.* 4. *Australis.* Pectens with thirty-two teeth; hands smooth, elongated and red; the fingers filiform; under the sting a pointed process.

Scorpio Australis. Linné, Fabricius.

Inhabits Africa.

Carpathicus. *Sp.* 5. *Carpathicus.* Pectens with eighteen teeth; hands angular; tail mucronated beneath the sting.

Scorpio Europæus, Linné, Fabr. *Scorpio Carpathicus,* Latr. *Scorpio Germanicus,* Herbst.

Arachnides.

The habitat is not known to us; but Latreille says it is an extra-European species.

** Eyes six in number.

Europæus. *Sp.* 6. *Europæus.* Pectens with nine teeth; hands somewhat heart-shaped, angular; the wrists with one tooth; body obscure brown; last joint of the tail, with the feet brownish-yellow.

Scorpio Europæus, Villers, Latreille.

Inhabits the south of Europe.

Linné was not acquainted with this species; he has described some other for it, and has led the celebrated Fabricius into a similar error respecting it: See the note following *Scorpio carpathicus, Sp.* 5. where we have corrected this mistake. De Geer has described a Cayenne species for *Europæus,* 7. 344. tab. 41. Fig. 5.

Maurus. *Sp.* 7. *Maurus.* Pectens with eight or ten teeth; hands cordate, nearly smooth; body fuscous, and granulated.

Scorpio maurus. Linné, Fabricius, and Latreille.

Inhabits Barbary.

58. Chelifer. Genus LVIII. Chelifer. Geoff. De Geer, Oliv. Lam. Herm. Latreille.

Phalangium, Linn. Scorpio, Fabricius. Obisium, Illiger, Walckenaer.

Maxillæ longitudinal, large and convex, on the inner side inflexed, and meeting together; the apex produced into a point. *Lip* none.

Eyes two or four inserted into the sides of the thorax.

Body somewhat depressed. *Tail* none.

* Eyes two. Thorax divided into two parts by a transverse line.

Cancroides. *Sp.* 1. *Cancroides.* Arms twice the length of the body, the second and third joints elongate and conic; body red-brown; abdomen oval.

Chelifer cancroides, Latreille.

Inhabits close places, and books, living on *Acaridiæ;* when touched, it walks backwards, holding forwards its hands in a menacing attitude.

Cimicoides. *Sp.* 2. *Cimicoides.* Arms of a moderate length, the joints somewhat oval and hairy; abdomen globose-oval.

Scorpio cimicoides, Fabr. *Pince parisite,* Hermann. *Obise cimicoide,* Walck. *Chelifer cimicoides,* Latr.

Inhabits Europe, under the bark of trees.

** Eyes four; thorax entire.

Trombidioidos. *Sp.* 3. *Trombidioidos;* mandibulæ very large and exserted; the second joint of the arms elongate; fingers long and straight.

Pince trombidioides, Latr. *Pince ischnochéle,* Hermann. *Chelifer trombidioides,* Latr. *Obisium trombidioides,* Leach's MSS.

Inhabits France; is common near Paris, under stones, and in other parts of France among mosses. In this country it has been discovered by Montagu and Leach, in Devonshire, under stones, in tolerable plenty; and by the latter gentleman in Surrey, near Godstone.

Obs. These two divisions of the genus certainly have distinct characters enough to form two genera; we therefore, perhaps, should follow Mr Leach, who proposes to call the first division Chelifer, a name first given by Geoffroy; the second Obisium, a name proposed by Illiger for the genus as it now stands.

59. Cellularia. Genus LIX. Cellularia. *Vide* synopsis of genera.

Method of Preserving the Animals of this Class.

Those of the first order may be simply dried, having a pin passed through the right side of their body; the legs being spread as if the animal were walking. The smaller species of the Second Order are to be glued to paper, by means of gum arabic; and the larger ones must either be kept in spirit, or dried very rapidly in a strong blast, in a dark place if possible.

APPENDIX.

Appendix. In this part of the article, we shall add those species which have been discovered since the former part was written, and some alterations in the classification, lately made by Dr Leach.

He has divided the tribe Millepeda from the Crustacea, and considered them as a distinct class, under the title of Myriapoda, and has placed the Oniscides and Asellides with the Gasteruri.

The characters of Crustacea, Myriapoda, Arachnides, and Insecta, are given in the following Table.

Animals without a Vertebral Column, with distinct Nerves and Feet.

- With gills or branchiæ. . . . . Class Crustacea.
- With air tubes or tracheæ.
  - With a heart.
    - With antennæ and distinct head. Class Myriapoda.
    - Without antennæ, head united to the thorax. Class Arachnides.
  - Without a heart. Class Insecta.

The genus Bopyrus is to be altogether rejected from this article, as it belongs to the class Vermes.

Class CRUSTACEA.

The two orders, I. Entomostraca, and, II. Malacostraca, he considers as sub-classes, but suffers them to retain the same names. In the Entomostraca, nothing new has occurred; but to the Malacostraca, we can add much valuable matter.

Subclass II. MALACOSTRACA.

This subclass is subdivided into three orders: 1. *Brachyuri, Macrouri,* and *Gasteruri,* which are synonymous with the tribes of those names before given.

Order I. Brachyuri.

The first division containing those genera with the hinder tarsus and unguis formed for swimming, is now (as we have before hinted) divided into more genera, the characters of which may be given in a table.

* The peduncle of the eyes as long as the external angles of the shell.

Genus I. Podopthalmus.

** Peduncle of the eyes much shorter than the external angles of the shell.

A. Shell with more than five teeth on each side.

Genus II. Lima. Shell remarkably transverse; at the termination of the semicircle on each side armed with a long spine.

B. Shell with five teeth on each side.

Genus III. Portunus. Transverse diameter of the shell much greater than the longitudinal; orbit of the eye behind, with two fissures. Eyes thicker than their peduncles.

Genus IV. Carcinus. Transverse diameter of the shell much greater than the longitudinal; orbit of the eye behind with one fissure; eyes not thicker than their peduncles.

Genus V. Portumnus. Longitudinal diameter of the shell equal, or nearly equal, to the transverse; or-

Appendix.

bit of the eye without any fissure behind; eyes not thicker than their peduncles.

The species of these genera have already been given in the early part of this article, under the generic title of PORTUNUS.

The genus CANCER, too, admits of several very important divisions, but three genera only have hitherto been formed, viz. CANCER, XANTHO, and ATELECYCLUS.

GENUS I. CANCER. Shell broad, the anterior margin gradually bent into a semi-elliptic form, the ends gradually converging into an angle behind, the apex truncate and marginate: the external antennæ setaceous and short, the two first joints largest; inserted betwixt the front and internal canthus of the eye: Peduncle of the internal antennæ somewhat lunate. Second joint of external double palpi, with the internal apex emarginate or notched for the insertion of the palpi: Feet simple, compressed, the hinder ones shortest. Nails somewhat compressed and hairy, the sides with an excavated line, joints naked and somewhat acute.

Sp. 1. *Pagurus*. See p. 391 of this article.

GENUS II. XANTHO. Shell as in Cancer, but the hinder edge is only submarginate. External antennæ very short, setaceous, the two first joints largest, inserted at the internal corner of the eye; peduncle of the internal antennæ somewhat linear. Palpi as in Cancer. Feet simple, compressed, hinder ones shortest. Nails compressed, hairy, the sides with an obscure impressed line, points naked, and scarcely acute.

Sp. 1. *Incisa*. Wrists with two tubercles above; shell on each side with four obtuse teeth, the interstices notched; fingers generally black, in some individuals same colour with the shell, which is most frequently reddish, or brownish-red.

Cancer incisus of this article. See p. 391.

Obs. 1. *Cancer dodone* of Herbst seems to be referable to this genus, as far as we can judge from his plate: it differs in having only three obtuse teeth on each side of the shell.

Obs. 2. *Cancer denticulatus*, *Hirtellus* and *Spinifrons*, seem also to form distinct genera, but the characters have not yet been developed.

GENUS III. ATELECYCLUS. The characters have not yet been completely developed; it is readily distinguished from any other genus by the form of its shell, which is almost continued from the front to the hinder edge into a circle, which is however interrupted in that part, forming altogether an imperfect or interrupted circle. The antennæ, too, are as long as the shell.

Sp. 1. *Septemdentatus*. With seven distinct teeth on the sides of the shell, and some intermediate small ones.

Cancer hippa septemdentatus, Montagu.

First discovered by Montagu on the S. coast of Devon, and described by him in the 11th vol. of the *Lin. Trans.* It has since been found by Mr Cranch of Kingsbridge to be very common in the Plymouth Sound. Dr Leach received the young of the female from the Bell Rock, sent him by Mr Stevenson. The full grown female has never yet occurred.

Cancer undecemdentatus of Herbst, tab. 10. fig. 60. seems to belong to this genus. It inhabits America.

The genus OCYPODE Dr Leach has also found it necessary to divide into the following genera.

* Shell rhomboidal, inclining to square; peduncle of the eyes reaching the anterior external angles of the shell.

GENUS I. OCYPODE. Peduncle extending beyond the eyes; anterior feet very unequal.

GENUS II. UCA. Peduncle not extending beyond the eyes; the anterior feet very unequal.

GENUS III. GONEPLAX. Peduncle not extending beyond the eyes; anterior feet equal.

** Shell truncate-heart-shaped; peduncle of the eyes much shorter than the anterior external angles of the shell.

GENUS IV. GECARCINUS.

To the genus OCYPODE, *O. ceratopthalmus* of this article are referable. To UCA, *Cancer uca* of Shaw's *Nat. Miscellany*, plate 588, belongs; the species to be named *Una*. To GONEPLAX, *O. Angulata* of this article, which should be named *G. bispinosa*, is the prototype. To GECARCINUS, *O. ruricola* and *cordata* of this article are the only species we know to belong to it.

GEN. GRAPSUS. To this genus *Cancer minutus* of Linné is referable.

GEN. PINNOTHERES.

Sp. 1. *Pisum*. (Female.) Shell orbicular, soft, very smooth, with the front somewhat arcuate and entire; hands oblong, the under part a line of ciliæ, as are the upper parts of the thighs of the other legs; thumb somewhat arcuate; abdomen very broad, the sides of the segments arcuate, the fifth segment broader; the last segment narrower than the preceding; the apex broadly notched.

Cancer pisum, Pennant, Fabricius, Linné.

Pinnotheres pisum, Latreille, Leach, *Mem. Wern. Soc.* vol. ii. *Mal. Brit.* PINNOTHERES, tab. A.

Inhabits the shells of mussels and oysters; male unknown.

Sp. 2. *Mytili*. (Female.) Shell orbicular, inclining to quadrate, soft, very smooth, the sides behind dilated; front strait, obscurely, somewhat notched; hands oblong; under parts, with the upper part of the thighs of the other legs, having a ciliated line; thumb somewhat arcuate; abdomen very broad, the segments at their sides somewhat arcuate; hinder edge of the third and following joints notched in the middle; fifth segment broader, the last narrower than the preceding.

P. Mytili. Leach, *Mem. Wern. Soc.* vol. ii. Malacostraca Britannica. PINNOTHERES, tab. A. Male unknown.

This interesting species was discovered by a most zealous and enlightened collector, Mr Cranch, in *Mytilus modiolus*, from the Kingsbridge estuary, dredged from the oyster bed near Gerston Point.

Sp. 3. *Mytilorum*. (Female.) Shell ovate-orbicular, anteriorly somewhat narrower, convex very smooth, somewhat solid; front produced entire, scarcely somewhat arcuate; sides in each side behind, with two oblique impressed lines running together behind; hands somewhat oval, beneath, with the upper part of the thighs with a ciliated line; fingers arcuate; abdomen somewhat narrow, the segments with their sides somewhat arcuate, the last narrower than the preceding, the apex somewhat acuminate, rounded at the extreme point, and entire.

Cancer mytilorum albus of Herbst.

Pinnotheres mytilorum of Latreille. Leach, *Mem. Wern. Soc.* vol. ii. Mal. Brit. PINNOTHERES, tab. A.

A single specimen of this species was taken by Dr Leach from *Mytilus modiolus*, dredged at Newhaven in the Frith of Forth, who, for a long time, considered it as the young of *P. Pisum*. Male unknown.

Sp. 4. *Varians*. (Male.) Shell ovate-orbicular, anteriorly somewhat narrower, convex very smooth, and solid; front produced, arcuate, and entire; hands ovate, beneath with two lines of ciliæ; fingers much arcuated; thighs above and below with a line of ciliæ; and sides of the abdomen broadly notched, the last joint abruptly narrower than the preceding, the apex narrower, rounded, and entire.

Cancer varians, Oliv. Enc. Meth. H. Nat. tab. vi. p. 155.
Cancer mytilorum fuscus, Herbst.

Inhabits *Mytilus modiolus*. Is common in the Frith of Forth, and was considered as the male of *Pisum* by Dr Leach, until the distinctions of the ciliated lines were pointed out to him by that acute and learned zoologist Montagu.

Sp. 5. *Pinnæ*. Front somewhat emarginate; hands beneath, with an arcuate emargination.

Male, with the shell transversely, somewhat quadrate, somewhat solid and punctate; hands ovate, fingers arcuate; sides of the abdomen entire, the last joint abruptly broader than the preceding, the apex acutely somewhat rounded.

Female, shell somewhat transversely, somewhat quadrate, soft, and very minutely punctate; hands elongate-ovate, with the fingers somewhat arcuate; abdomen very broad, with a kind of carina of knots, the fifth, sixth, and seventh segments emarginate behind, the last joint narrower than the preceding.

Cancer Pinnotheres, Linné?

Pinnotheres pinnæ, Leach, *Mem. Wern. Soc.* vol. ii. Malacos. Britan. PINNOTHERES, tab. B.

Mus. Montagu, male and female. *Mus.* Leach, female.

Discovered by Montagu in *Pinna ingens*, from the Salcombe estuary; since which, Mr Cranch has taken two females out of the same shell from the same situation.

Sp. 6. *Modioli*. (Male.) Shell transversely, somewhat quadrate, somewhat solid, and punctate; front emarginate; hands ovate, fingers arcuate; sides of the abdomen widely notched, the last joint somewhat abruptly broader than the preceding, the apex obtusely rounded and entire.

Pinnotheres modioli, Leach, *Mem. Wern. Soc.* vol. ii. Malacost. Brit. PINNOTHERES, tab. B.

Discovered by Montagu in *Mytilus modiolus*, from the Kingsbridge estuary. Female unknown.

The paper by Leach here quoted as in "Mem. Wern. Soc. II" is not in that publication.

The reference to "Malacos. Brit" is obviously to proof plates. That work began in 1815 & the plates have numbers. In the text of that work this article is cited, but no reference made to "Mem. Wern. Soc.

paper to which we have alluded, has been ...

* Abdomen with seven joints.

The genera in this division have been examined but not defined; we shall, however, give the name of the genera, with one species of each genus.

GENUS I. PARTHENOPE, Fabricius.

Sp. 1. *Maia Horrida* of this article, see page 394.

GENUS II. MAIA.

Sp. 1. *Squinado* of this article, see p. 394. This species is improperly mentioned as the *Dodecos* of Linné by Montagu, in the seventh volume of the *Linnean Transactions*, when he describes his *Cancer maxillaris*.

GENUS III. HYAS.

Sp. 1. *Araneus*. *Maia Araneus* of this article, see p. 394.

GENUS IV. EURYNOME.

Sp. 1. *Aspera*. *Cancer asper* of Pennant. As full grown specimens have not yet occurred, we cannot give the specific characters.

GENUS V. BLASTUS.

Sp. 1. *Tetraodon*. *Cancer tetraodon* of Pennant; and also probably *Maia armata* of Latreille.

GENUS VI. PISA.

Sp. 1. *Biaculeata*. *Cancer biaculeatus*, Montagu, *Lin. Trans.* vol. ix.

** Abdomen with six joints.

GENUS I. INACHUS. Exterior antennæ, with the three first joints largest; eyes distant; feet very long and slender, the anterior pair excluding the arms, thicker than the three hinder pair; shell somewhat triangular, scantily spined, and rostrated in front, with a projecting spine on each side over the eyes, which protects them as it were in a spurious orbit.

Sp. 1. *Dorsettensis*. Rostrum short and tricuspid, with equal teeth, middle one acute placed beneath; shell behind the rostrum, with four small equal tubercles disposed in a strait transverse line; behind these three spines, the middle one placed rather more anteriorly; behind these again, three others stronger and more acute, placed in a recurved line; the hinder margin, with two distant obsolete tubercles.

Cancer dorsettensis of Pennant. *Cancer Scorpio*. Fabr. *Ent. Syst.* *Inachus Scorpio*. Fabr. *Sup. Ent. Syst.*

Inhabits the western coasts of England. Is common at the mouths of rivers, and in deep water far from land.

Sp. 2. *Dorynchus*. Rostrum somewhat lanceolated, with a fissure running down the middle; shell behind the rostrum, with three spines placed in a triangle, the hinder one largest; behind these are two tubercles, one on each side, then four other tubercles, one on each side, and two in the middle near to one another, placed somewhat behind the lateral ones; posterior margin with two distant obsolete tubercles.

This was discovered by Dr Leach, whilst he was washing some specimens of I. *Dorsettensis*, sent him by Mr Prideaux and Mr Cranch from the Kingsbridge estuary.

Leach, *Malacos. Brit. Inachus*,

...IA. Exterior antennæ, with the ... eyes distant; first pair of legs ...ollowing legs; shell somewhat ...l, anteriorly rostrated; no spine

...*aia phalangium*, see p. 395, which ...th *Cancer rostratus* of Herbst. This differs from *Phalangium*, ... longer and narrower, and the

...th Sound. First noticed as dis-

I. MACROURI.

GENUS PENÆUS. See page 401. To the generic character add *pediform palpi*, with five exserted joints, last joint obtuse and simple.

GENUS ALPHÆUS. See page 400. To this genus, *Cancer spinus* of Sowerby, described in the *British Miscellany*, is referable. The *pediform palpi* with three exserted joints, the last joint furnished with spines.

Sp. 2. *Trisulcatus*. Back of the thorax with three grooves; rostrum turning downwards, with two teeth beneath and many above.

Penæus trisulcatus, Leach, *Malacos. Brit.* PENÆUS, tab. A.

Mus. Sowerby.

Discovered in Anglesea by the Rev. H. Davies, who sent it to Mr Sowerby.

GEN. HIPPOLYTE. Superior antennæ with two setæ, the lower seta largest, the upper compressed; pediform

Appendix. palpi, with three exserted joints, the last spiniferous; four anterior feet, didactyle, the anterior pair shortest and thickest; nails of other feet spinous; third joint of abdomen gibbous above.

Observe. To this genus *Cancer astacus gibbosus* of Montagu, already referred to in the note after *Penæus*, page 401, belongs.

Sp. 1. *Varians.* Rostrum strait, with two teeth above and beneath; shell above and beneath the eyes with a spine.

Inhabits the rocky shores of Devon in great plenty.

Hippolyte varians; Leach, *Mem. Wern. Soc.* vol. ii.

There are other species which are not well understood.

Gen. Pandalus. Superior antennæ with two setæ, the inferior ones with a squama at their base. First pair of feet simple, the second pair didactyle; nails of the other feet spinulose; third segment of the abdomen gibbous above; pediform palpi, with three exserted joints, the last acuminate and spinigerous.

Sp. 1. *Montagui.* Rostrum turning upwards, with many teeth above, and the apex emarginate, with six teeth beneath; antennæ ringed with white and red alternately.

Pandalus Montagui, Leach, *Malacos. Brit. Pandalus,* Tab. A. named in honour of the first discoverer, Montagu, by whom it was called *Astacus maculatus.* The Rev. J. Fleming took this species in Zetland, whose successful labours, in that country speak more than we can do in words.

Gen. Palæmon. Page 401. A. Anterior pair of feet smaller than the second; pediform palpi, with the last simple and acuminate, shorter than the preceding joint; superior antennæ with three setæ.

Observe. We can correct an error in nomenclature, which we have lately discovered.

Sp. 1. *Serratus.* Rostrum ascending, above with from six to eight teeth, and the apex notched; beneath with from four to six teeth.

Astacus serratus of Pennant. *Palæmon squilla* of Latreille; and this article, page 401. *Palæmon serratus* of Fabricius, seems referable to a distinct genus, from his description, if it be correct.

Sp. 2. *Squilla.* Rostrum strait, with from seven to eight teeth above, and two to three beneath.

Cancer squilla, of Linné.

Is very common on the Devonshire coast; has the same colour as *P. serratus,* but spawns at a different season. A little shorter than the preceding species.

Sp. 3. *Varians.* The rostrum strait, with from four to six teeth above and three beneath.

Is common at Yarmouth, and is frequently also taken on the Devon and Glamorgan coasts.

Gen. Athanas. *Palæmon.* Page 401. B. Anterior larger than the second pair of feet; pediform palpi, with joint simple and acuminate longer than the preceding; superior antennæ with three setæ.

Sp. 1. *Nitescens.* *Palæmon nitescens.* Page 401.

ORDER III. GASTERURI.

Tribe I. GNATHIDES.

This includes our former family, *Gnathonii.*

Tribe II. GAMMERIDES.

This tribe includes our family *Gammarini,* which is now divided into several families. The last character, viz. "tail not distinct from the body," should be cancelled.

Family I. Orchestidæ.

Antennæ four jointed, the last joint composed several minute joints; the upper ones very short, shorter than the peduncle of the under ones.

Genus I. Talitrus. Page 402. Appendix.

Sp. 1. *Locusta.* Dr Leach has discovered *T. littoralis* to be merely the other sex of this species.

Genus II. Orchestia. Page 402. Four anterior feet of the male monodactyle, the second pair largest; of the female equal in size, the first pair monodactyle, the second didactyle.

Family II. Dexameridæ.

Antennæ three-jointed, the last joint composed of several other minute articulations; upper ones longest.

* *Two anterior pair of feet monodactyle.*

Genus III. Dexamine. Four anterior feet nearly equal; hands subovate, compressed, and filiform.

Sp. 1. *Spinosa. Cancer gammarus spinosus* of Montagu.

** *Anterior pair of feet didactyle; second pair monodactyle.*

Genus IV. Leucothöe. Thumb of anterior feet with two joints; second pair with a compressed hand, furnished with a curved thumb.

Sp. 1. *Articulosa.* Page 403.

Family III. Gammaridæ.

Last joint of the antennæ composed of several minute articulations; upper pair longest, four jointed; under ones five-jointed.

* *Second pair of feet larger than the first, with a compressed hand.*

Genus V. Melita. Second pair of feet (in the male at least) with the thumb bending upon the palm; last joint of the antennæ entire.

Sp. 1. *Melita palmeta.* Page 403.

Genus VI. Mæra. Second pair of feet with a large compressed hand and single thumb; last joint of the antennæ bifid.

Sp. 1. *Grossimana.* Page 403.

** *Four anterior feet nearly equal in size and form, with ovate hands.*

Genus VII. Gammarus. Last joint but one of the superior antennæ with a litle seta at the apex at the base of the articulated last joint; back of the tail with ciliæ of spines.

Contains *Gammarus pulex, locusta,* and *camylosps* of this article, page 402 and 403.

Genus VIII. Ampithöe. Superior antennæ, without a seta at the base of the last joint; back of the tail without fasciculi of spinules.

Sp. 1. *Rubricata. Gammarus rubricatus.* Page 403.

*** Four anterior feet with a filiform hand.

Genus IX. Pherusa.

Sp. 1. *Fucicola.* Colour whitish, nuttled with reddish.

Found on the rocky shores of Devon, under stones at low tide, on fuci.

Family IV. Podoceridæ.

Superior antennæ shortest four-jointed, the last joint solid or obscurely articulated; inferior antennæ five-jointed, with the last joint solid, or very obscurely articulated.

* *Superior antennæ very short, the last joint composed of many minute articulations.*

Genus X. Corophrium. Body elongate, ten-jointed; tail three-jointed, the first joint and the second with a bifid style; the last with two moveable papillæ; anterior pair of feet small, with the apex somewhat truncate, and furnished with a little thumb; second pair larger, armed with a thin curved thumb.

Dr Leach formerly considered this genus as constituting a peculiar family, which, with the addition of two other genera, he has now completely established as such. For the species, see page 403.

Appendix.

** Superior antennæ shorter than the under ones; the last joint scarcely articulated.

Genus XI. Podocerus. Eyes hemispherical and somewhat prominent; four anterior feet didactyle, anterior pair smallest with an elongate-subovate hand; second pair with an ovate hand, and the internal side nearly strait.

Sp. 1. *Variegatus.* Body, legs, and antennæ beautifully variegated with red.

Podocerus variegatus. Leach's MSS.

Inhabits the rocky shores of Devon, walking about on fuci and corallines with its antennæ as well as legs.

Genus XII. Jassa. Eyes not prominent; four anterior feet didactyle with ovate hands; the anterior pair smallest; the hand of the second pair with the internal edge furnished with teeth.

Sp. 1. *Pulchella.* Thumb of the second pair with the internal edge emarginate at the base.

Var. α. Internal edge of the hand of the second pair of feet with an elongated tooth at the base.

Var. β. Internal edge of the second hand with three teeth.

Iassa pulchella. Leach, *Mem. Wern. Soc.* vol. ii.

Inhabits fibrous fuci on the Devonshire coast every where. White painted with red.

Sp. 2. *Pelagica.* Hand of the second pair with the internal edge having a lunar notch.

Iassa pelagica. Leach, *Mem. Wern. Soc.* vol. ii.

Received through Mr Stevenson's kindness from the Bell Rock, in the German Sea.

Cancer gammarus falcatus of Montagu. *Lin. Trans.* vol. ix. tab. 5. fig. 2. seems referable to this genus.

Tribe III. PHRONIMARIDES.

Extremity of the tail furnished with several styles; feet ten.

This tribe contains the genus Phronima, mentioned in p. 403, which might constitute a distinct family.

Tribe IV. CAPRELLIDES.

This includes our family Caprellini, to which we can add another genus, differing from *Caprella* in having true legs instead of the gelatinous fine-like legs, which is naved.

Gen. Proto.

Sp. 1. *Pedata.*

Cancer gammarus pedatus. Montagu, *Linn. Trans.* vol. xi. p. 6. tab. ii. fig. 6.

Tribe V. APSEUDIDES.

Comprehending our family Apseudii, p. 404.

Tribe VI. ASELLIDES.

Antennæ four, distinct; last segment of the tail long.

Family I. Anthuridæ.

Last segment of the tail very short, the last narrow, elongate, with two elongate lamellæ on each side; antennæ nearly equal, inserted one behind the other in nearly an horizontal line.

Genus II. Anthura. See Genus LXV.

Family II. Cymothoidæ.

Last segment of the tail with one or two appendages on each side; antennæ placed in pairs, one above the other.

Stirps 1. Last segment of the tail on each side with a single appendage.

Genus III. Campecopea. See Genus LXIX.

Genus IV. Nesæa. See Genus LXVIII.

Stirps 2. Last segment of the tail with two appendages on each side.

* Upper antennæ with a very large peduncle; head behind bilobate, the eyes placed on the lobes.

Genus V. Cymodoce. Eyes touching the anterior margin of the first segment; base of the tail on each side with two equal slightly compressed (but not foliaceous) appendages, exterior ones largest; last segment emarginate, with a lamella in the middle; nails bifid.

Sp. 1. *Truncata.* Apex of tail truncate.

Inhabits the coast of Devon amongst fuci, but is very rare. Leach's MSS.

Oniscus truncatus, Montagu's MSS.

Genus VI. Dynamene. Eyes not reaching the anterior margin of the first segment; base of the tail on each side with two equal foliaceous appendages, apex of the tail emarginate; nails bifid.

There are several indigenous species of this genus, but the characters are not yet determined.

Genus VII. Sphæroma. Eyes not reaching the anterior margin of the first segment; last joint of the tail entire, the base on each side furnished with two equal foliaceous appendages; nails bifid.

Sp. 1. *Serrata.* Add to the character given in p. 405. "External foliaceous appendage of the tail externally serrated."

Sp. 2. *Rugicauda.* Add, "foliaceous lamellæ not serrate externally."

Sp. 3. *Hookeri.* Last joint of the tail with two oblong obsolete tubercles.

Spheroma Hookeri. Leach, *Mem. Wern. Soc.* vol. ii.

Discovered by Mr W. J. Hooker on the Norfolk coast.

** Peduncle of upper antennæ not very large.

Genus VIII. Cymothoa. Head narrower than the first segment of the body, and received into a notch in that part; eyes obscure; tail narrower than the body, the last segment of the tail transversely quadrate, with two styles on each side at the base.

Sp. 1. *Œstrum,* page 405.

Genus IX. Limnoria. Head as broad as the first segment of the body; eyes granulated and distinct; tail scarcely narrower than the body; last segment of the tail rounded at the apex; the base in each side with two styles.

Sp. 1. *Terebrans.* Body cinereous; eyes somewhat pitchy-black.

Limnoria terebrans. Leach, *Mem. Wern. Soc.* vol. ii.

Length from one line to two.

This new and highly interesting species was sent to Dr Leach by Mr Stevenson, from the Bell Rock, in logs of wood, which it perforated in the most alarming manner. He has since received it from the coast of Suffolk. It generally produces seven young ones.

Family III. Asellidæ.

Last segment of the tail very large; middle antennæ very short; external antennæ half the length of the body, or more.

Stirps 1. Tail with two styles at the apex; antennæ filiform.

Genus X. Idotea. External antennæ half the length of the body, or scarcely longer, the third and fourth joints equal; body ovate.

Sp. 1. *Entomon,* see p. 404.

Sp. 2. *Œstrum,* see p. 404.

Genus XI. Stenosoma. External antennæ longer than the body, the third longer than the fourth joint; body linear.

Sp. 1. *Hectica.* Apex of the tail truncate.

Idotea hectica of this article. See page 404.

Sp. 2. *Acuminata.* Apex of the tail acuminate.

Stenosoma acuminata. Leach, *Mem. Wern. Soc.* vol. ii.

Taken on the Devonshire coast by Dr Leach.

Stirps 2. Apex of the tail with two bifid styles; antennæ setaceous.

* *Styles very minute, scarcely exserted; anterior feet like the others; without a head.*

Genus XII. Jæra. Eyes of the middle size inserted betwixt the sides of the head and the vertex.

Sp. 1. *Albifrons.* Head anteriorly whitish.

Oniscus albifrons, Montagu's MSS.

Jæra albifrons. Leach, *Mem. Wern. Soc.* vol. ii.

Inhabits the British sea every where, under stones and amongst fuci.

** Styles of the tail exserted; anterior feet larger than the others, with a moveable thumb.

Genus XIII. Janira. Nails bifid; eyes of a moderate size, inserted on the sides of the head towards the vertex.

Sp. 1. *Maculosa.* Light cinereous, mottled with brownish speckles.

Oniscus maculosa, Montagu's MSS.

Janira maculosa. Leach, *Mem. Wern. Soc.* vol. ii.

Inhabits the Devonshire coasts, under stones, but is rare.

Genus XIV. Asellus. Nails simple; eyes minute and lateral.

Sp. 1. *Aquaticus,* see p. 404.

Tribe VIII. ONISCIDES.

Internal antennæ very minute, scarcely discernible.

Family I. Ligidæ.

Caudal styles two on each side, sitting on a common peduncle in hairs.

Genus XV. Ligia, see Genus LXXI.

Sp. 1. *Oceanicus.* *Ligia scopulorum* is merely a variety of this species, see p. 406, as we have found every intermediate variety in size and sculpture.

Family II. Oniscidæ.

Caudal styles two on each side, the lateral one two-jointed.

Stirps 1. Body not contractile into a globe.

* External antennæ with eight joints.

Genus XVI. Philoscia, see Genus LXXII.

Genus XVII. Oniscus, see Genus LXXIII.

** External antennæ with seven joints.

Genus XVIII. Porcellio, see Genus LXXIV.

Stirps 2. Body contractile into a globe.

Genus XIX. Armadillo, see Genus LXXV.

This genus intimately connects the Orders Tetracera with the Duocera.

Class MYRIAPODA.

Order I. CHILOGNATHA.

Includes Fam. 20. Julides of this article. p. 387 and 407.

Family I. Glomeridæ.

Body contractable into a ball.

Genus XX. Glomeris. Feet on each side sixteen. See p. 407.

Genus XXI. Cryxus. Feet on each side twenty. See p. 407.

Family II. Julidæ.

Body not contractable into a ball.

Stirps 1. Antennæ inserted on the superior margin of the head.

* *Eyes distinct and granulated.*

Genus XXII. Julus. See Gen. p. 407.

Genus XXIII. Craspedosoma. See Gen. Julus ** p. 407.

** *Eyes obsolete.*

Genus XXIV. Polydesmus. See Gen. LXXVIII.

Stirps 2. Antennæ inserted under the anterior margin of the head.

Genus XXV. Polyxenus. See Gen. LXXIX.

Order II. SYNGNATHA.

Family I. Scutigeridæ.

Segments of the body bearing four feet.

Genus XXVI. Scutigera. See Gen. LXXX.

Family II. Scolopendridæ.

Segments of the body with a single pair of feet.

Stirps 1. Last pair of feet remarkably larger than the rest.

* Feet thirty.

Genus XXVII. Lithobius. See Gen. LXXXIII.

** Feet forty.

Genus XXVIII. Scolopendra. See Gen. LXXXI.

Genus XXIX. Cryptops. See Gen. LXXXII.

Stirps 2. Last pair of feet not very much larger than the rest.

Genus XXX. Geophilus. See Gen. LXXXIV.

Class ARACHNIDES.

Those of this class having but six feet, may be arranged in a more perfect manner: we can add one new genus, and the genus *Nycteribia* of Latreille is also referable to this division, although he has placed it with the insects.

Hexapoda.*

Tribe I. Cephalostoma.

Mouth situated in the head.

Family I. Phænorhynchi.

Mouth porrected and easily to be seen.

Genus I. Caris. See Gen. IV.

Genus II. Leptus. See Gen. V.

Genus III. Ocypete. Mouth rostriform, porrected betwixt the palpi.

Palpi elongate-conic, incurved, the last joint acute, corneous, and nail-like, abruptly narrower than the preceding, underneath at the base with a conic (soft?) elongate moveable appendage. Body soft, oval, smooth, the upper part anteriorly, as if divided into two parts by a transverse line; the anterior division a little narrower, and bearing the mouth, eyes, and four anterior feet. Two eyes on each side close to one another, prominent, (or placed on a peduncle?), inserted above the base of the anterior feet. Feet six-jointed, the last joint of the anterior pair thickest.

Between the eyes, which are inserted longitudinally, there is a black spot above the base of the rostrum.

This genus seems akin to the *Trombidia* in the parts of the mouth at least.

Sp. 1. *Rubra.* Body red, back with a few long, and the feet with many short rufous hairs, inclining to ash-colour. Eyes blackish brown.

Dr Leach took no less than sixteen specimens of this interesting little parasite, from one tipularous insect in Devon.

Family II. Aphænorhynchi.

Mouth hidden.

Genus IV. Astoma. See Gen. VI. of this article.

Tribe II. Notostoma.

Mouth placed on the back.

Genus V. Nycteribia. Latreille, Montagu, *Lin. Trans.* vol. xi.

Pthiridium. Hermann.

Celeripes. Montagu, *Lin. Trans.* vol. ix.

Sp. 1. *Vespertilionis.*

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Class II. ARACHNIDES.

CRUZ, Santa, or St Croix, is one of the three Caribbee Islands which formerly belonged to Denmark, but which was taken by the British in December 1807. This island is about 20 leagues long, and four broad, and is intersected by several small rivers. The soil is extremely fertile, but the climate is unhealthy at particular seasons of the year. The island is divided into 350 plantations, by lines drawn at right angles to each other, and each plantation contains 150 acres of 40,000 square feet. About two-thirds of the land is fit for sugar, and the other kind is employed in a less lucrative manner. Nearly forty years ago a gold mine was discovered in this island. Sixteen pounds of ore furnished eighty Danish *rix dollars* of gold, finer by two carats than the purest gold of Holland. The vein was about 10 feet deep, and 10 feet thick. It is said that a copper mine has likewise been discovered near the embouchure of the river of Santa Cruz.

This island is said to have supplied Denmark with five-sevenths of its colonial produce. It produces about 35,000 hogsheads of sugar annually, besides tobacco and fruits; about 8000 puncheons of rum, and 150 cwt. of cotton.

The official value of the exports and imports of this island, in 1809 and 1810, were,

	Imports.	Exports.
1809	L.435,378	L.84,964
1810	422,033	89,949

During the same years, the following were the principal articles imported into Great Britain:

Years.	Coffee. British Plant.	Coffee. Foreign Plant.	Sugar. British Plant.	Sugar. Foreign Plant.	Rum in Gallons.	Cotton Wool.
	Cwt.	*Cwt.*	*Cwt.*	*Cwt.*		*lbs.*
1809	297	1479	280,211	374	181,594	610,903
1810	31	—	290,933	—	236,307	174,294

The island of Santa Cruz was first occupied, in 1643, by the English and the Dutch; but jealousies having soon arisen among them, the Dutch were driven out, after a very obstinate engagement, in 1646. In 1650, the English were attacked and defeated by 1200 Spaniards, who arrived in five vessels; and the Spaniards had not possessed the island a single year, when they abandoned it to the French, who were sent out from St Christopher's for the purpose of seizing it. In the year 1696, the colonists, to the amount of 147 men, with their wives and children, and 623 blacks, left the island, after demolishing its forts, and went to St Domingo. Santa Cruz continued without colonists, and without cultivation, till the year 1733, when it was sold by France, to a company of Danish merchants, for 1,611,000 *rix dales*. It continued in the possession of this company till 1801, when it was taken by the English, by whom it was restored to Denmark in the same year of the battle of Copenhagen. The English again took it in 1807, and it has since continued in our possession.

The following was the state of the population in 1796.

Whites	2223
Free Negroes	1164
Negro slaves	25,425

West Long. of the harbour 64° 48′ 29″. North Lat. 18° 28′ 40″. See Oxholm's *Account of the Danish West India Islands.* (π)

CRUZ, Santa, a seaport town in the island of Teneriffe, is pleasantly situated, and has a tolerably handsome appearance. The streets are narrow, but well paved, and the houses are large and roomy. Upon the beach there is a handsome alameda, or mall, about a hundred fathoms long, shaded with several rows of trees, and formed at the expence of the inhabitants, by the late governor, the Marquis de Branciforte. A centinel stands at the entrance to prevent persons from enjoying it, and we are informed by Krusenstern, that Mr Barry, a merchant, pays one hundred piastres annually for the privilege of walking upon it. In the great square there is a well sculptured marble pillar, adorned with emblematic figures, and erected in honour of the Virgin Mary de la Candelaria. Opposite to this pillar is the fort of St Christopher's, where Lord Nelson lost his right arm in his attempt to take the town. There is also a well built pier stretching into the sea, and several level and agreeable walks and rides in the neighbourhood of the town.

Krusenstern found here abundance of grapes, peaches, citrons, oranges, melons, onions, and potatoes. He paid 90 piastres for a pipe of Teneriffe, seven for a moderate sized sheep, one for a fowl, and eightpence the pound for beef. "The general misery of the people," says this intelligent navigator, "the depravity, in the highest degree, of the other sex, and swarms of fat monks, who stroll about the streets as soon as it is dark; these are the characteristics of Santa Cruz, and strike the stranger, unaccustomed to such sights, with pity and disgust. There is no place in the world where so many horrid objects are to be seen. Beggars of both sexes, and of all ages, clad in rags, and afflicted with every kind of disgusting complaint, fill the streets, together with lewd women, drunken sailors, and lean and deformed thieves. I am almost tempted to believe that the lower class of inhabitants here have all an equal propensity to stealing. A person might fancy himself transported to one of the islands of the South Seas; for he is robbed in spite of the greatest attention and precaution. Whenever a boat came along side the ship, some theft was infallibly committed in the presence of the whole crew, and I was at last obliged to prevent any body from coming on board." See Krusenstern's *Voyage round the World*, in the years 1803, 1804, 1805, and 1806. Lond. 1813, vol. i. p. 45—50. See also Teneriffe. (j)

CRUZITA, a genus of plants of the class Tetrandria, and order Digynia. See Botany, p. 127.

CRYPSIS, a genus of plants of the class Diandria, and order Digynia. See Botany, p. 91.

CRYPTOCARYA, a genus of plants of the class Enneandria, and order Monogynia. See Brown's *Prodr. Plant. Nov. Holl.* &c. p. 402, and Botany, p. 208.

CRYPTOCEPHALUS. See Entomology.

CRYPTOGAMIA. In the article Botany, we referred to the present article for an account of the plants which compose this class, but after the greatest exertion to procure the foreign works which have been recently published on this subject, and without which an original article could not have been written, we are under the necessity of again referring our readers to another part of our work. See Filices, Fuci, Fungi, Lichen, and Musci.

CRYPTOLEPIS, a genus of plants of the class Pentandria, and order Monogynia. See *Wernerian Transactions*, vol. i. p. 58, and Botany, p. 178.

CRYPTOSPERMUM, a genus of plants of the class Tetrandria and order Monogynia. See Botany, p. 131.

CRYPTOSTOMUM, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 145.

CRYSTALLOGRAPHY.

Crystallography. History.

CRYSTALLOGRAPHY is that branch of science which treats of the forms and structure of crystals.

The word *crystal* (κρυσταλλος) among the Greeks, signified *ice*. It was likewise applied to what we at present call rock crystal, or quartz, because it was the opinion of the Greek philosophers that this mineral was merely water frozen by the cold, and converted into stone. Hence they conceived that rock crystal occurred only in high mountains, where the temperature is always low. But the word *crystal* in the English and other modern languages has a very different signification. It is a name given to all those regular figures (usually bounded by plain surfaces) which a great variety of bodies assume; thus, what in common language is called *sugar-candy*, is nothing else than sugar crystallized. These crystals, when examined, will be found to be four-sided or six-sided prisms, terminated at the ends by dihedral or trihedral summits. In like manner, saltpetre usually occurs crystallized in six-sided prisms, and common salt in regular cubes. Epsom salt occurs in four-sided prisms, with square bases, and alum in regular octahedrons, while the figure of the garnet is a dodecahedron with rhomboidal faces. At first the term crystal was confined to those regular bodies which have a certain degree of transparency, and therefore was conceived to be peculiar to saline bodies. But at present the idea includes nothing more than regularity of shape, and it belongs to many bodies not in the least degree analogous to salts in their nature.

The remarks made upon crystals by the ancients are not entitled to any attention: Nor are the researches of Huygens, Newton, &c. respecting the form of calcareous spar, intimately connected with our subject. The first person that attempted to form a catalogue of the different crystalline forms was Linnæus, and he made it the basis of his classification of minerals. His classification was very incomplete, and his arrangement erroneous, and in many cases absurd; yet it deserves to be mentioned, because it drew the attention of mineralogists to the subject, and constituted, in some measure, the beginning of the study. Romé de Lisle studied the subject in a very different manner. He formed a very numerous collection of crystallized minerals, examined the shape of each crystal with particular care, measured all the angles, and compared the relative sizes of the different faces. Now it happens that the same mineral very frequently occurs in a variety of shapes. Thus calcareous spar sometimes assumes the form of a rhomboidal prism, sometimes of a six-sided prism, sometimes of a dodecahedron, not to mention a great variety of other forms common to this mineral. Fluor spar occurs sometimes in cubes, sometimes in octahedrons. Quartz is sometimes crystallized in rhomboidal prisms, differing little from a cube, sometimes in six-sided prisms terminated by six-sided pyramids. To account for this variety of forms, Romé de Lisle assumed some particular form, generally the most simple he could find, which he considered as the natural shape of the mineral; and he shewed how all the other crystalline shapes of the species were derived from this primitive form, by a number of supposed truncations of its edges, or angles, or both. Thus the cube, when its right angles are sufficiently truncated, is converted into an octahedron.

Linnæus.

Romé de Lisle.

This method of Romé de Lisle was very ingenious. It served to connect together all the different crystalline forms of the same mineral, and familiarised the minds of mineralogists with the forms of crystals, and thus very much promoted the progress of mineralogy. His method was adopted by Werner, the celebrated Professor of Mineralogy at Freyberg. It is affirmed by the pupils of Werner, that the method of Romé de Lisle was in fact the method of Werner, communicated to the French mineralogist in the course of a correspondence between them. But as during the 40 years that have elapsed since the first publication of Romé de Lisle's book, no such claim has ever been publicly made by Werner, it is obvious that such assertions are entitled to no attention, and that Romé de Lisle has a right to the full credit of his method.

Werner.

But this method, though ingenious and useful, was entirely arbitrary. No reason could be assigned for the various and capricious truncations to which the primitive form was subjected. Nor could any conjecture be formed of the number of crystalline forms which were likely to occur in the same species, far less of their forms and angles. A great and fundamental improvement was made by Bergman. The first edition of his Essay was published in the year 1773, the very year in which the first edition of Romé de Lisle's Crystallography appeared. As we have never had an opportunity of seeing this first edition, we do not know how much it differs from the second edition, published in the year 1780, in the second volume of his *Opuscula*. He observed that the secondary forms of crystals always contain a nucleus of a determinate shape, which may be obtained from them by a skilful dissection. Thus calcareous spar, whatever be its shape, always yields a nucleus which is a rhomboidal prism with determinate angles. He shewed how all the secondary forms may originate from this primitive one, by the addition of slices of certain determinate shapes to each of its faces. According to Bergman, it was Assessor J. G. Gahn who first observed the rhomboidal nucleus of calcareous spar. We have been informed that it had been detected before by Mr Keir of Birmingham, who mentioned his discovery in his English translation of Macquer's *Chemical Dictionary*. We have not had it in our power to consult this translation since we were informed of the circumstance, and therefore we cannot say how far Mr Keir is entitled to the merit of the discovery.

Bergman.

This idea of Bergman was taken up by the Abbé Hauy, or rather indeed the same idea occurred to him before he had any information of what had been done by Bergman. For he informs us that his first dissertations on the subject had been presented to the Academy of Sciences before he had any information of Bergman's Dissertation, and that this dissertation was communicated to him by the Academy as likely to interest him, because it treated of the same subject with his own. Be that as it may, the subject has been prosecuted ever since by the Abbé Hauy, with the most indefatigable industry, and brought by him to an un-

Abbé Hauy.

Theory.

looked for degree of perfection. He has formed a complete theory of crystallography, and drawn up according to it a system of mineralogy, which was published in 1801. Though many unavoidable mistakes occur in this work, which have been gradually corrected since, and though many of his primitive forms are in fact hypothetical, and may turn out erroneous, yet the work must be admitted to be altogether extraordinary, to constitute an era in the science of mineralogy, and to develope a theory not only highly curious in itself, but exceedingly useful and important.

We shall divide this article into three Chapters. In the first we shall give such a popular view of the theory of crystallization, as will, we flatter ourselves, be intelligible to all our readers. In the second Chapter, we shall give the mathematical theory which is necessary for all who wish to prosecute the subject farther, or who would be able to judge of the accuracy of the labours of Hauy, or indeed to understand them. In the third Chapter, we shall give a table of the forms of the crystals of all minerals, as far as the subject has been hitherto investigated.

Chap. I.

Theory of the Structure of Crystals.

Theory of the structure of crystals.

To give a general notion of the structure of crystals, we shall describe Hauy's mechanical dissection of a six-sided prism of calcareous spar, and the discovery of the primitive nucleus, because it was the circumstance that led to the discovery of the theory of the structure of crystals, such as we have it at present. While looking over the cabinet of M. Defrance, a hexahedral prism of carbonate of lime broke off a group to which it was attached. M. Defrance made him a present of it. This crystal had a corner broken off from the base by which it had been attached to the group. M. Hauy attempted to detach similar corners from the other angles, and after some time succeeded in bringing to view its rhomboidal basis. This excited in him a movement of surprise, and first suggested to him the theory of the structure of crystals. His method of proceeding in the dissection of this crystal, may be understood from the following description.

Hauy's method of dissecting carbonate of lime. Plate CCXXII. Fig. 1.

Take a regular six-sided prism of calcareous spar, (Plate CCXXII. Fig. 1, and 2.) if you attempt to divide it parallel to the edges of the base, you will find that three of these edges, taken alternately in the upper base; for example, the edges *lf, cd, bm*, will admit of this division, while the other three of them will not. To succeed in the lower base, you must not make choice of the edges *l'f', c'd', b'm'*, which correspond with the upper edges; but the alternate edges *d'f', b'c', l'm'*. Fig. 2. These six cuts will expose to view as many trapeziums. Three of these are represented in Fig. 2; namely, the two which come in place of the edges *lf, cd*, and which are marked by the dotted lines *p p o o, q a k k*, and that which comes in place of the lower edge *d' f'*, and which is marked by the dotted lines *n n i i*.

Fig. 2.

Each of these trapeziums will have a polish and lustre, from which it will be easy to perceive that they coincide with the natural joints of the prism. You will attempt in vain to divide the prism in any other direction; but if you continue the division parallel to the first cuts, it is obvious that the size of the bases will continually diminish, while the prism itself will continually grow shorter. Just when the bases disappear altogether, the prism will be converted into a dodecahedron, (Fig. 3.) with pentagonal faces; six of which, as *ooiOe, oIkii*, are the remains of the faces of the prism, and the six others, E A I *oo, oa' kii*, are the result of the mechanical division.

Plate CCXXII. Fig. 3.

If we continue the dissection, the faces at the ends will preserve their figure and size, while the lateral faces will continually diminish in length, till at last the points *o, k* of the pentagon *oIkii* being confounded with the points *i, i*, and the same thing happening with all the other points similarly situated, each pentagon is converted into a simple triangle, as we see in Fig. 4. New slices taken off some make the triangles disappear, so that no vestige of the original prism remains. Thus we obtain the nucleus, or primitive form, (Fig. 5.) which consists of an obtuse rhomboid,† the inclination of whose faces is 105°, and the plane angles of the rhombs 101° 52′ and 78° 8′.

This example will suffice to give the reader some notion of the manner of dissecting crystals, and of obtaining their primitive nucleus. There are a great many other crystalline forms of carbonate of lime; but all of them, when properly dissected, give a rhomboidal nucleus, precisely similar to that obtained from the hexahedral prism in the preceding example. A very common crystalline shape of this mineral is the dodecahedron, represented in Fig. 6. consisting of two six-sided pyramids applied base to base. This is the crystal, the nucleus of which was found by Bergman. Nothing is easier than to detect the primitive crystal here. We have only to make cuts parallel to the edges EO, OI, and to the other edges, where the bases of the two opposite pyramids unite. This will be evident by inspecting Fig. 7. in which the primitive nucleus is represented, and the same letters are employed, as in Fig. 6. to denote the same parts of the dodecahedron.

It would be easy to multiply examples; but we conceive that the two preceding ones will suffice to give our readers an idea of the way in which the primitive nucleus may be detected, which is all that we have in view at present. All crystals do not admit of this mechanical division; but in them, what is called the cleavage, and which is in fact the direction of the natural joints of the crystal, may frequently be detected. These, assisted by the theory, as we shall see afterwards, are generally sufficient to give us a pretty near approximation, at least, to the primitive form of these bodies.

Primitive forms.

All the different primitive forms hitherto observed may be reduced to six; namely,

1. The parallelopiped.
2. The octahedron.
3. The tetrahedron.
4. The regular six-sided prism.
5. The dodecahedron with rhomboidal faces, equal and similar.
6. The dodecahedron, with triangular faces, consisting of two six-sided pyramids applied base to base.

I. The parallelopiped, as every body knows, is a solid figure, bounded by six faces parallel to each other, two and two. Thus, for example, a cube is a parallelopiped. From this definition, it is obvious that there may be an infinite number of parallelopipeds, differing

† By a *rhomboid*, in this article, is always meant a figure bounded by six equal rhombuses, parallel two and two.

Theory. Parallelopiped.

from each other in the proportional length and breadth of their faces, and in the angles which these faces make with one another. About 40 different parallelopipeds have been hitherto observed in the mineral kingdom. It may be useful to give a kind of general arrangement of them here. They may be divided into nine distinct kinds. The following description will give some notion of each of these.

1. The first is the cube. It is a well known rectangular figure bounded by six square faces, all equal to each other. Now it deserves attention, that this and all the other regular mathematical figures which occur in the mineral kingdom, constitute the primitive forms of a variety of species, while the other figures, which do not possess this mathematical symmetry, are confined to one species. The cube, for example, constitutes the primitive form of no less than 11 species of minerals; as examples may be mentioned, common salt, pyrites, galena, native gold, silver, and copper.

2. The second is a right quadrangular prism with square bases. It is a cube somewhat longer in one direction than the other. Of course the only way it can vary is in the relative lengths of two contiguous faces, the base, and one of the faces of the prism. For all the faces of the prism are, of necessity, equal and similar, being all rectangles. There are seven species which have this kind of primitive form. In four of these the prism is shorter than the square base, while in three it is longer. Meionite, wernerite, sulphate of magnesia and mesotype, have the prism shorter than the base; while in Vesuvian, chromate of lead, and titanite, it is longer.

3. The third is likewise a rectangular prism, but the base, instead of a square, is a rectangle; of course it admits of greater variation than the preceding, as both the length of the base and of the prism may vary. Yet, as far as we recollect at present, only six species of minerals have been hitherto observed, whose primitive forms belong to this variety of parallelopiped. These are apophyllite, euclase, chrysoberyl, tungsten, chrysolite, and foliated zeolite.

4. The fourth is likewise a rectangular prism, but the base is a rhomb. Hence it is nearly in the same circumstances with the second kind; the square in it being a rhomb in this kind. The primitive forms of sulphate of barytes, sulphate of strontian, arsenical pyrites, mica and granatite. There may be others that belong to this kind of form, though we do not at present recollect them.

5. The fifth kind is likewise a rectangular prism; but the base is an oblique angled parallelogram. It bears the same relation to the third kind that the fourth does to the second. We recollect at present only three species of minerals that have this primitive form; namely, pistazite, axinite, gypsum, and borax. They differ from each other of course in the relative proportions of the faces, and in the angles of the base.

6. The sixth kind is an oblique angled prism, the base of which is a rhomb. Hornblende, actinolite, augite and grammatite, are species, which have this kind of primitive form.

7. The seventh kind is an oblique angled prism, the base of which is an oblique angled parallelogram. Felspar and sulphate of copper belong to it. If there be any other minerals that have this primitive form, we do not recollect them at present.

8. The eighth kind is a rhomboid with an obtuse summit. The distinction between this and the succeeding kind is rather artificial than real. But it deserves attention, because it is useful in the theory, and facilitates the description of crystals. By a rhomboid, in crystallography, is meant a figure bounded by six equal and similar rhombs. So that it is nothing more than an oblique angled cube, or a cube twisted a little awry; and in some of the species, the deviation of the rhomboid from the cube is not very evident to the eye. This is, in some measure, the case with the primitive figure of quartz, and still more with that of chabasie, to which the name of cubic zeolite, on that account, has been often given. Now, if you examine the eight solid angles of any of the rhomboids belonging to this kind, you will find that two of them, which are opposite to each other, differ from the other six. They are composed each of three obtuse plain angles meeting together in a point; whereas the six others are formed of two acute and one obtuse angle. The line joining these obtuse solid angles is called the *axis* of the crystal, and the angles themselves constitute the *summits* of the crystal. The axis is the *shortest* line joining any two opposite angles in the respective rhomboids. The following species belong to this kind of parallelopiped. Calcareous spar, red silver ore, quartz, chabasie, dioptase or copper, emerald, and tourmaline.

9. The ninth kind is a rhomboid with an acute summit. If you examine the eight solid angles of these rhomboids, you will find two of them to differ from the other six. They are formed by the inclination of three acute plain angles to each other, whereas the other six are composed of two obtuse and one acute plain angle. The line joining these two acute and opposite solid angles, is called the axis of the crystal, and the angles themselves are called the summits. This axis is the *longest* line joining any two opposite angles of the crystal. The species of minerals belonging to this kind of rhomboid, are sulphate of iron, corundum, and oligiste iron ore. The primitive form of the two last differ but little in appearance from a cube.

Octahedron.

II. The second primitive form is the octahedron. The simplest way of forming a notion of this figure, is to conceive two four-sided pyramids applied base to base; thus united they form the octahedron. There are about 30 species of minerals which have the octahedron for their primitive form. They may be divided into four kinds.

1. The regular octahedron. In it the triangular faces are equilateral and equiangular, and, of course, the base of the two pyramids is a square. A considerable number of minerals have the regular octahedron for their primitive form. We recollect at present 11 different species. The following are their names: alum, salammoniac, fluor spar, diamond, spinel, magnetic iron ore, native antimony, native bismuth, red copper ore, native amalgam, muriate of copper.

2. Octahedron composed of two pyramids, having rectangular bases applied base to base. Each triangular face, of course, is isosceles, the two angles at the base being equal, and the angle at the summit different. It may be either acute, rectangular, or obtuse, according to the length of the rectangular base of the pyramids. The faces are equal and similar, four and four. The following species have this primitive form: carbonate of lead, sulphate of lead, calamine, topaz, chiastolite, nitrate of potash, and perhaps also arragonite.

3. Octahedron composed of two pyramids having a square base. The pyramids, in general, are very low, when compared with the size of the base, though this

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is not always the case. In anatase, for example, they are long, and of course the solid angle at their summit is composed of very acute plane angles meeting at a point. The following species of minerals have this primitive form: tinstone, zircon, molybdate of lead, mellite, harmolome or cross-stone, and anatase.

4. Octahedron composed of two pyramids terminated by a rhomboidal base. They vary from each other in the height of the pyramids, and the angles of the rhomb constituting the common base of the pyramids. Sulphur, carbonate of soda, realgar, and sphene.

Tetrahedron.

III. The regular tetrahedron is a figure bounded by four equilateral and equiangular triangles; or it may be conceived as a three-sided pyramid terminated by a triangular base. There are but few minerals which have this figure for the primitive form of their crystals. At present we recollect only grey copper ore, and copper pyrites.

Regular six-sided prism.

IV. The regular six-sided prism is a prism composed of six equal rectangles, and terminated at each extremity by a regular hexagonal base. They differ from each other in the height of the prism compared with the diameter of the base. The following species of minerals have this primitive form: apatite, carbonate of strontian, emerald, cinnabar, sulphuret of copper, pinite and sommite.

Rhomboidal dodecahedron.

V. The rhomboidal dodecahedron is a solid bounded by twelve equal rhombs. It is a beautiful, but not very common primitive form. Every body must have observed, that it is the shape which garnets usually affect. We recollect no mineral species, except garnet and blende, which have the rhomboidal dodecahedron for the primitive form of their crystals.

Triangular dodecahedron.

VI. The last primitive form is the triangular dodecahedron. It may be conceived to consist of two six-sided pyramids applied base to base. The common base, of course, is a regular hexagon. This is by no means a common primitive form. Carbonate of barytes and phosphate of lead are the only two species that we recollect in which it occurs. In the first of these, the pyramids are long compared to the diameter of the base; in the second, they are short.

From the preceding account of the primitive forms of crystals, it is obvious that two of them, namely, the parallelopiped and the octahedron, are by far the most common, and include by far the greatest number of primitive forms. The six-sided prism is likewise not uncommon. But the other three primitive forms, namely, the tetrahedron, the rhomboidal dodecahedron, and the triangular dodecahedron, are comparatively insignificant, occurring only each in about two species. However, as these species happen to be very well marked and important, they could not be passed over without impropriety.

After we have obtained the primitive crystal of a mineral by mechanical division, it very frequently happens that we can still continue the mechanical division, either by cutting off slices parallel to the faces of the primitive crystal, or in some other direction, when any natural joints become evident. If we continue the mechanical division of calcareous spar by cutting off slices parallel to the faces of the crystal, the only directions that admit of mechanical division, it is obvious that the figure of the substance will continue the same. It will diminish in size; but will experience no other change. Suppose, on the other hand, that we continue to cut slices from a six-sided prism, by cuts parallel to the faces of the prism, the consequence would be that we would divide the whole prism into a number of triangular prisms. This will be evident to the eye, by inspecting Fig. 8. which represents the basis of a hexagonal prism, divided into triangular prisms by such continued divisions.

Plate CCXXII. Fig 8.

Sometimes a parallelopiped admits of divisions in other directions, besides those parallel to the faces. Suppose the rhomboid AA′KH, Fig. 9. divisible both in the direction parallel to the six rhombs which constitute its faces, and likewise in planes passing through the oblique diagonal AO, the axis A′A and the edge A′O comprehended between the diagonal and the axis, the consequence of such a division would be, that the rhomboid would be separated into six tetrahedrons, as any person may satisfy himself by a little consideration. These tetrahedrons are represented in the Figure surrounding the original rhomboid; and, to aid the conception, the same letters are employed to denote the same parts in the rhomboid, and in the tetrahedrons into which it is conceived to be divided.

Fig. 9.

These examples of the ultimate changes which may be produced upon the primitive crystals by mechanical division, will be sufficient to give the reader an idea of the subject. Hauy conceives, that, by these divisions, we obtain the form of the integrant molecule, or of the ultimate integrant atom of the mineral in question. No proof can be advanced in proof of this conjecture, except the impossibility of altering the form, how far soever we carry on divisions, and the obvious consequence, that, if these divisions be carried far enough, we must at last reduce the crystal to its integrant particles. The subject is not of much importance, as far as crystallography is concerned; because the theory of crystals is not in the least affected either by its truth or its falsehood; and no use whatever is made of the integrant molecules in any part of the theory. We must acknowledge, that the reasoning of the Abbé Hauy appears to us plausible. It may therefore be adopted, at least for the present, without any inconvenience.

Integrant molecule.

That all minerals have integrant molecules of a determinate shape, and that this shape never varies in the same species, we conceive to be incontrovertible. M. Delametherie, indeed, has endeavoured to prove, that the integrant molecule varies in its form in the same species; but his arguments are founded entirely upon the opinion of Berthollet, that substances are capable of uniting indefinitely in a great variety of proportions,—an opinion entirely refuted by all the phenomena of chemistry, and which no chemist can well maintain, without refusing his assent to the best demonstrated truths in the science. We do not therefore think it necessary to enter into any examination of the arguments advanced by Delametherie in support of his opinion, as they are arguments which no chemist can admit, and which, of course, are not calculated to produce conviction.

Hauy has found, that the integrant molecules of all crystals, supposing them capable of being discovered by mechanical division, may be reduced to three species; namely, the tetrahedron, the triangular prism, and the parallelopiped. Now, it deserves attention, that these are the three simplest conceivable solid bodies, being bounded respectively by four, five, and six faces,—the smallest number of faces by which a solid body can be bounded. It is needless to observe, that each of these figures is capable of a good many varieties, by alterations in the proportions, and the angles of the respective faces.

It may be worth while to give a few examples of the

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different minerals in which these various integrant molecules occur. The tetrahedron, varying, of course, in its respective angles and dimensions, is the integrant molecule of quartz, nitrate of potash, topaz, chiastolite, calamine, carbonate of lead, sulphate of lead, phosphate of lead. The triangular prism, equally various in its dimensions, is the integrant molecule of the emerald, augite, axinite, granatite, pinite, sommite, vesuvian, mesotype, sulphate of magnesia, sulphate of barytes, sulphate of strontian, appatite, cinnabar, sulphuret of copper, titanite, chromate of lead. The parallelopiped is so common, that numerous examples are unnecessary. We may mention common salt, pyrites, calcareous spar, as familiar instances.

When these integrant molecules happen to be regular mathematical figures, it is not uncommon to find them belonging to more than one species. Thus the cube is the integrant molecule of common salt and of pyrites; but when this regularity does not exist, we find every species have an integrant molecule of its own, distinct in shape from that of every other species.

After having determined the primitive forms of crystals, the next point is to determine the laws which the integrant molecules observe in arranging themselves, so as to produce the great variety of secondary crystals, which belong to every mineral species. The Abbé Hauy has shewn, that these secondary forms may be accounted for, and the structure subjected even to calculation, by supposing that layers of integrant molecules arranged so as to form plates, are applied successively to all the faces of the primitive crystal, while each successive plate diminishes in size by the abstraction of a determinate number of integrant molecules (or parallelopipeds), either parallel to the edges, or the diagonals of the faces, or in some other direction. We shall endeavour to make this structure, which constitutes the basis of the theory, intelligible to our readers by some simple examples. The decrements may be either parallel to the edges, to the diagonals, or in an intermediate direction between the two. It will be proper to give examples of each of these decrements.

1. *Decrements on the Edges.*

Decrements on the edges.

Let us suppose that the primitive form of a mineral species is the cube; but that secondary crystals of the same species likewise occur, having the form of the rhomboidal dodecahedron. How is this dodecahedron derived from the cube? Let us suppose, as may be done in every case, that the integrant molecule of this species is a cube; it follows that the primitive cubic crystal is formed by the congeries of a number of cubes. Suppose these cubes of such a size that an edge of the primitive crystal is composed of seventeen of these small cubes applied side by side. Of course every face of the primitive crystal will be composed of 289 squares, consisting of the bases of so many integrant molecules. According to this supposition, the primitive crystal will be a congeries of 4913 little cubes. Let us now suppose, that a square, consisting of the thickness of one integrant molecule, be applied to every face of the primitive crystal; but that, instead of being of the size of the face of that crystal, it be less than it by a single row of integrant molecules all round, so that its side, instead of 17 little cubes, contains only 15; and of course it contains only 225 little cubes instead of the 289 that go to the formation of the face of the primitive crystal. Upon each of these first plates applied all round to every face, let another plate be applied similar to the first, but less than it by a row of integrant molecules, so that the side contains only 13 squares, and the whole plate only 169 squares. Let six other plates be applied in succession to each of the faces, diminishing by a row of little cubes all round, so that the sides of each consist of 11, 9, 7, 5, 3, 1, squares, respectively. It is obvious, that, by this process, we have raised upon each of the six faces of the cube a four-sided pyramid, the faces of which, instead of being smooth, will, by their constant diminution in bulk, represent the steps of stairs. Each of these pyramids having four faces, constitute small 24 triangular faces; so that, by this process, we have converted the cube into a new crystal. It would seem, at first, that this new crystal ought to have 24 triangular faces; but a little consideration will satisfy us, that the two adjacent triangular faces, in each pyramid, are in the same plane, and form together a rhomb; so that, in fact, the cube has been converted into a rhomboidal dodecahedron. Fig. 10. represents the cubic nucleus, with the pyramids raised upon three of its faces; and Fig. 11. represents the rhomboidal dodecahedron formed in this manner. This is an example of a secondary crystal formed by decrements on the edges of the plates. Suppose us in possession of such a crystal, it is easy to see how, by mechanical division, the cubic nucleus might be extracted. We would have only to cut off all the solid angles formed by four plain angles, by slices parallel to the shorter diagonals EO, OI of the rhombs.

Plate CCXXII. Fig. 10. Fig. 11.

In the preceding example, each plate was only of the thickness of one integrant molecule, and the decrement was only one row of integrant molecules all round; but we might have supposed the thickness of the plates to have equalled two or more integrant molecules, and the decrements might have been equal to two rows of integrant molecules, or more, at once. In that case, the form of the secondary crystal obtained would have been different from the rhomboidal dodecahedron.

Decrement in breadth.

It will be necessary here to explain the meaning of two terms, which we will have occasion to employ frequently hereafter. *Decrement in breadth* is used when the thickness or height of the plate is only equal to one integrant molecule; but one, two, three, &c. rows of molecules all round, we conceive to be abstracted from the breadth of each succeeding plate. *Decrement in height* is used when the plates only diminish by one row of integrant molecules in breadth, but their height may be equal to two, three, &c. molecules. In such cases, the decrement is expressed by saying, that it takes place by two, three, &c. rows in height.

Decrement in height.

It will be worth while to give another example of a secondary crystal formed by decrements on the edges of the faces. The primitive form of pyrites is a cube; but, among a great variety of secondary crystals, there is one which occurs in the form of a rhomboid with pentagonal faces. This crystal is represented in Fig. 12. where the cubic nucleus may likewise be seen. From the inspection of that Figure, it will be obvious, that, instead of a four-sided pyramid, as in the former case, a kind of wedge is formed upon each face of the cubic nucleus, which may be conceived to be the pyramid elongated in one direction. This wedge upon one of the faces of the cube, is represented by OO′ *t n* I I′. In this case, the decrements may be conceived to take place by two ranges in breadth between the edges OI and AE, I I′ and OO′, EO and E′O′; and in the same manner upon the opposite faces; while, at the same time, they take place by two ranges in height between

Fig. 12.

the edges EO and AI, OI and O′I′, OO′ and EE′. We see that these decrements take place upon the different faces of the cube in three directions, which cross each other at right angles. The decrement, by two ranges in breadth, tending to produce a face more inclined than that which results from a decrement by two ranges in height, the consequence must be, that the structure of plates does not terminate in a point, as in the first example, but in a wedge. The lines *p q*, *t n*, (Fig. 12.), represent the summits of two of these wedges. If we compare these summits *p q*, *t n*, with the summit *r s* of the wedge which covers the face EOO′E′ of the cubic nucleus, it will be easy to perceive that these three lines are perpendicular to each other respectively. Fig. 13. represents the cubic nucleus with wedges raised upon two of its contiguous faces by means of plates pursuing decrements according to the law above described. The same letters are applied to the same parts of the crystal in Figs. 12. and 13. At *s*′ is seen the extremity of the summit of a third wedge raised upon a third face of the cube. Each trapezium, such as O *p q* I (Figs. 12 and 13.), being in the same plain with the triangle O *t* I belonging to the adjacent wedge, both together conspire to form the pentagon *p* O *t* I *q*, so that the secondary crystal formed by these decrements, instead of 24 faces, has only 12 pentagonal faces, and is therefore a dodecahedron as well as the first example, but a dodecahedron of a different kind.

Plate CCXXII. Fig. 12.

Fig. 13.

We shall give a third example of these kind of decrements, because it contains something peculiar in it, but which often takes place in the formation of secondary crystals; and it is requisite that the reader should be aware of it. The dodecahedron represented in Fig. 6. is a secondary crystal of calcareous spar. In it the edges EO, OI, IK, &c. where the two opposite pyramids join, coincide with the edges of the primitive nucleus, as may be perceived by inspecting Fig. 7. The decrements set out from these edges, and do not take place at all upon the other six edges of the primitive nucleus EA, AI, AG, OA′, &c. Now, it is easy to conceive, that the edges of the plates laid upon the primitive nucleus, form, by their sum, as many triangles E *s* O, I *s*′ O, E *s*′ O, &c. resting upon the edges from which they set out; and as these lines are six in number, there will be 12 triangles, six above, and as many below; and all these triangles will be scalene, in consequence of the obliquity of the edges from which the decrements set out.

Fig. 6.

Fig. 7.

With respect to the other edges of the plates of superposition, they will be so far from experiencing any decrement, that they will, on the contrary, augment, because they must always remain contiguous to the axis of the crystal, just as happens when the primitive crystal increases in size by the superposition of new plates, without undergoing any change of form. It is the province of mathematics, combined with observation, to determine the law of decrement upon which this dodecahedral form depends. If we suppose a decrement of one range, it may be demonstrated that the two faces produced on each side of the edge from which the decrement set out, will be in the same plain, and parallel to the axis of the primitive crystal, circumstances which do not suit the present case. If we suppose a decrement of two ranges in breadth, it may be demonstrated that the result will be a dodecahedron similar to the one which we are considering. Hauy has pitched upon this law in the present case, influenced by several very plausible geometrical considerations, which, however, we are afraid will not be found to hold so accurately as he supposed, seduced by an inaccurate measurement of the angles of the primitive crystal of calcareous spar. Fig. 14. represents one of the pyramids of this dodecahedron formed by the superposition of plates following the law of decrements by two ranges of particles. The line E *s* represents an edge of this pyramid such as it appears to the eye, E *s* such as it really exists; but the distance *s s*′ is not sensible, in consequence of the extreme minuteness of the size of the intermolecules, by the abstraction of which the pyramids are formed. The same reason prevents the channels or steps of stairs upon the pyramids from being sensible. Though in some cases, when secondary crystals are formed with great rapidity, these channels may be perceived by the naked eye.

Plate CCXXII. Fig. 14.

We conceive the preceding illustrations are sufficient to explain what is meant by the decrements on the edges of crystals. Let us now proceed to the second kind of decrement.

2. *Decrements on the Angles.*

Decrements on the angles.

Decrements on the edges, which have been just described, are not sufficient to account for all the diversity of forms which secondary crystals assume. To give an example; mineral species, the primitive form of whose crystals is the cube, are found crystallized in secondary forms, some of which are rhomboidal dodecahedrons, and others regular octahedrons. The formation of the rhomboidal dodecahedron has been explained above, by means of decrements on the edges. At first sight, it would appear that the octahedron might also be derived from the cube by decrements on the edges. We have only to take two opposite faces of the cube, and to suppose a four-sided pyramid raised upon each by means of decrements on the edges of the plates successively applied. While this is going on upon these two faces, we may suppose that the other four faces of the cube remain unaltered. Each of these two pyramids may be supposed to prolong itself downwards till they meet. The consequence would be an octahedron enveloping the cubic nucleus; but it may be demonstrated, that no law of decrement whatever could in this case form an octahedron with equilateral triangular faces, which is the case with the octahedron derived from the cube. Besides, if we have recourse to mechanical division, in order to obtain the cubic nucleus from this kind of octahedron, we shall find that the solid angles of the cube coincide with the central points of the eight faces of the octahedron, which could not be the case if the octahedron had been formed in the way we have been supposing. But if we suppose the decrements to take place parallel to the diagonal of the faces of the cube, all difficulty vanishes; we obtain the regular octahedron without difficulty. Such decrements are called *decrements on the angles*.

Let OI I′O′ (Fig. 15.) be one of the faces of the cubic nucleus, divided into a number of little squares, which are the bases of as many molecules. We may conceive these molecules arranged in two different ways; they may be parallel to the edges, as is the case with the molecules *a*, *n*, *q*, *r*, *s*′, *t*′, *v*′, *z*′, *s*′; or they may be arranged in the direction of the diagonals, as is the case with the molecules *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, and likewise with the molecules *n*, *t*, *l*, *m*, *p*, *o*, *r*, *s*, and likewise with the molecules *q*, *v*, *k*, *u*, *x*, *y*, *z*. One of these rows of molecules is represented separately in Fig. 16.

Fig. 15.

Fig. 16.

The molecules parallel to the edges of the square

Theory. touch by one of their faces, and the ranges themselves are simply placed contiguous to each other. The molecules parallel to the diagonals touch only by an angle, and the ranges are indented into each other. When secondary crystals are formed by this last kind of decrement, the new faces are not merely channelled, as happens in the case of decrements on the edges; they are all bristled with points, which being exceedingly minute, and all in the same plane, escape the eye, so that the faces appear smooth.

Having thus explained the meaning of the terms, let us illustrate this kind of decrement by an example; and we cannot get a better than the formation of a regular octahedron from a cubic nucleus. This is the consequence of the superposition of plates upon each face of the cube with decrements of a single range of molecules on the angles. Let AEOI (Fig. 17. A) be one of the faces of the cubic nucleus subdivided into 81 little squares, which are the bases of so many molecules, of which the face is conceived to be composed.

Plate CCXXII. Fig. 17. A.

Fig. 17. B. Fig. 17. B, represents the first plate of superposition, which ought to be placed above AEOI (Fig. 17. A) in such a manner, that the point e' corresponds with the point e; the point a' with the point a; the point o' with the point o; and the point i' with the point i. It is obvious, from this manner of placing it, that the squares Ee, Aa, Ii, Oo, (Fig. 17. A), remain uncovered; which is the initial effect of the decrement on the angles. We see likewise, that the edges QV, PN, LC, FG, (Fig. 17. B), exceed by a range of molecules the edges EA, EO, OI, IA, (Fig. 17. A). This is necessary to prevent re-entering angles, and is merely the consequence of the increase of size of the crystal, without any change of form in these quarters.

Fig. 17. C. The upper face of the second plate of superposition, is represented by BKHD (Fig. 17. C). It must be applied to the first plate in such a manner, that the points e'', a'', i'', o'', coincide with the points e', a', i', o', (Fig. 17. B), which leaves bare another row of molecules parallel to the diagonal. This plate also increases by a row of molecules at all its edges B, K, H, D, for the same reason as the first plate did.

The figure of these plates of superposition, which at first was an octagon, has now become a square. It is no longer necessary to continue the addition of rows of molecules at the edges; so that the succeeding plates retain the square shape, but constantly diminish in size, in consequence of the abstraction of a row of molecules from each edge parallel to the diagonal of the face of the cubic nucleus. These different plates are represented by Fig. D, E, F, G, H, and I, in each of which the small accented letters denote the points of the plate that coincide with the same letters in the preceding plate. Eight plates are necessary, as appears from the Figure, and the last of them consists only of a single molecule.

Fig. 17. D, E, F, G, H, I.

If we suppose the same number of plates, of the same form, to be applied successively upon each face of the cubic nucleus, it is obvious that we raise upon each of the six faces of the cube a four-sided pyramid. Hence it would appear, at first sight, that the secondary crystal would have 24 faces. Each of these faces will have four edges, as must appear evident upon a little consideration, and will have the form represented in Fig. 18. in which the angle o is conceived to coincide with the angle O of the cubic nucleus, and the diagonal $t\,x$ represents the edge HK (Fig. 17. C) of the plate BKHD. The triangle $t\,o\,x$, being composed of those plates of superposition, the edges of which undergo an increment, will be much shorter than the triangle $t\,s\,x$ formed of those plates of superposition whose edges undergo no increment; because the number of the first is much smaller than that of the second, they being to each other as 2 to 6.

Fig. 18.

Thus the surfaces of the secondary crystal is composed of 24 quadrilateral faces, arranged, three and three, round each angle of the cubic nucleus. But as in the decrements, by one range of molecules on the edges, the faces produced on both sides of the same edge are in the same plane, so in decrements by one range of molecules on the angles, the faces formed on the three sides of each angle are in the same plane. This plane is represented in Fig. 19. where the three quadrilaterals surrounding the angle of the cube o, coincide to form the equilateral triangle $m\,n\,s$. Thus the faces of the secondary crystal are reduced to eight equilateral triangles, and of course the figure is that of the regular octahedron.

Plate CCXXII. Fig. 19.

If these decrements were to stop before they terminated in a point, the consequence would be, that faces would remain parallel to the original faces of the cube. The consequence would be, that the crystal would have fourteen faces, eight those of the octahedron, and six those of the cube; so that it would at once have the form of the cube and of the octahedron. Nothing is more common than to find such crystals both in pyrites and galena.

If the decrements were more rapid, as, for example, if two or more ranges of molecules were abstracted, then the three trapezoids $s\,t\,o\,x$, $m\,t\,o\,r$, $n\,r\,o\,x$, (Fig. 19.) formed round the same solid angle of the nucleus, would not be in the same plain, but would be inclined upon each other, and the secondary crystal would have 24 trapezoidal faces.

As another example of this kind of decrement, let us take the rhomboid, Fig. 20. which differs somewhat from a cube by having acute angles. Let us suppose that the plates applied upon all the faces of this rhomboid suffer decrements only at the angles contiguous to the summits A, O', and that these decrements take place by two ranges; then, instead of 24 faces, only six would be formed: and if we conceive these prolonged till they meet each other, they would compose a very obtuse rhomboid, which would be the secondary crystal. Fig. 21. represents such a rhomboid, with its primitive nucleus enclosed. We see that its summits A, O' coincide with the summits of the primitive rhomboid, from which the decrements commenced, and that each of its faces, as A $e\,o\,i$, corresponds with one of the faces AEOI of the nucleus, so that the diagonal which passes through the points e, i is parallel to the diagonal EI of the face of the nucleus, and only somewhat more elevated. This kind of crystal is found among the secondary crystals of *Oligiste iron ore*.

Fig. 20.

Fig. 21.

The decrements which take place upon the angle, whether superior or inferior, are susceptible of different variations, respecting which, it may be proper to make some observations before we proceed farther. Let G g (Fig. 1.) be any rhomboid whatever, the summits of which are S, s. Let Sg'' s G$''$ (Fig. 2.) be a quadrilateral figure formed by cutting through the rhomboid G g in the direction of a plain formed by the two oblique diagonals Sg'', sG$''$ (Fig. 1.) and the edges SG$''$, $s\,g''$ contained between these two diagonals. This quadrilateral figure, termed by Hauy the principal section of the rhomboid, is divided in the Figure into a number of similar small quadrilaterals, representing the principal section of as many molecules. Let SGg''G'

Plate CCXXIII. Fig. 1. Fig. 2.

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Plate CCXXIII. Fig. 3.

(Fig. 3.) be the face of the rhomboid (Fig. 1.) marked with the same letters, subdivided into the bases of the molecules of which it is composed. If we suppose that the angle g'' undergoes a decrement by a single row of molecules, the small rhomboid represented by $o\,n\,z\,g''$ will be wanting; hence, it is obvious, that the edge of that plate will have the direction $o\,z$, and that the distance between the angle g'', from which the decrement sets out, and the edge $o\,z$, will be measured by the semidiagonal $r\,g''$ of a molecule. If the decrement takes place by two ranges, the edge of the first plate of superposition will correspond with $c\,d$, and the distance between it and the angle g'' will be measured by the diagonal $g''\,n$ of a molecule. From this we may conclude, that, in general, in decrements on the angles, the distance between one plate and the succeeding one, which is the same with that of the angle from which the decrements began, and the first plate of superposition, is equivalent to as many semidiagonals of a molecule as there are ranges taken away; while, in the case of decrements on the edges, the distance between two successive plates is equivalent to a number of diagonals equal to that of the molecules taken away.

This being understood, let us suppose a decrement of two rows upon the angle g''. In that case, the quadrilateral $n\,e\,a\,p$ (Fig. 2.) being a section made on the first plate of superposition, the edge of that plate in which the decrement takes place will coincide with en, since $g''n$ is the same diagonal as in Fig. 3. Therefore, if we draw the straight line $g''eh$, it will coincide with the face produced by the decrement. But in this case $g''h$ is parallel to the axis S s, as may be easily demonstrated by the assistance of mathematics. Hence it follows, that the secondary faces constitute the faces of a prism.

If the decrements went on more rapidly, if they took place, for example, by four ranges, in which case the edge of the first plate of superposition will coincide with the line $y\,g$, then the line $g''q$S$'$ indicates the position of the secondary faces. We see that they rise above the nucleus, and form the surface of a rhomboid more acute than this nucleus. If, on the other hand, the decrements took place in height, then the line $ug''s'$, which we suppose to indicate the secondary faces produced, would incline towards the inferior portion of the axis. Hence, it is obvious, that the faces of the secondary crystal (still a rhomboid) would incline in the opposite direction of the primary faces.

The hypothesis of a decrement by two ranges in height, gives, in this case, a remarkable result; the secondary crystal is precisely similar to the primitive. Hauy has made it probable that such secondary crystals exist both in quartz and tourmaline.

Let us pass to the superior angle S, and let us suppose at first a single range of molecules taken away. If from t, the centre of the equal diagonal Sp, we draw $t\,x$ parallel and oblique to $p\,a$, this line will coincide with the edge of the first plate of superposition, since the distance between the angle S and the edge is equal to a semidiagonal of a molecule. Hence the line S$x\,h$ will coincide with the secondary face produced by the decrements, which is obviously perpendicular to the axis.

A more rapid decrement, as by two ranges in breadth, would produce faces inclined as the line S $a\,i$ is; that is to say, that the secondary crystal would be a rhomboid, inclined as the nucleus, and more obtuse. If the decrement takes place in height, then the secondary faces produced, one of which corresponds with the line KS m, will incline to the other side of the axis; hence the secondary rhomboid will have a position the reverse of the primary.

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These observations and examples we conceive sufficient to make the nature of the decrements on the angles obvious to every reader who takes the trouble to consider the subject. But there is still other kinds of decrement which remain to be explained.

3. *Mixed Decrements.*

Mixed decrements.

This name is applied to those decrements in which the number of ranges taken away in breadth and height give ratios, the two terms of which surpass unity. As, for example, decrements by two ranges of molecules in breadth, and three in height, or by three ranges in breadth and two in height, &c. It is easy to see that the theory may be with facility reduced to that of decrements, in which there is only one row of molecules taken away in one of the two directions.

4. *Intermediate Decrements.*

Intermediate decrements.

We have seen, that in the case of a decrement by one row of molecules round the same solid angle, the three faces produced are always in the same plain, and that, in that case, it is only necessary to consider the effect of the decrement with respect to one of the plain angles which concur to the formation of the solid angle, conceiving this effect to be prolonged over the neighbouring faces. In that case, the decrements on these last faces are considered as *subsidiary*, to favour the action of the principal decrement.

In general, whenever the solid angle of a primitive crystal undergoes decrements which tend to produce a face in its place, whatever the law may be to which we reduce the production of that face, there are always auxiliary decrements, the concurrence of which is necessary, in order that the new face may be of the requisite magnitude. Now, when the decrement which we consider in preference takes place, by two ranges of molecules, or by a greater number, the auxiliary decrements in continuity with it follow a peculiar law, which it is necessary to explain.

Plate CCXXIII. Fig. 4.

Let AA$'$ (Fig. 4.) be a parallelopiped of any kind which undergoes a decrement by two ranges on the angle EOI of its base AEOI. It is obvious that the edges of the plates of superposition will have the directions $b\,c$, $r\,s$, parallel to the diagonal EI, and so situated that there will be upon the sides OE, OI two rows of molecules comprehended between the angle O and the line $b\,c$, and likewise between $b\,c$ and $r\,s$. But, as has been already said, the plates applied upon the adjacent faces IOA$'$K, EOA$'$H undergo likewise auxiliary decrements, which continue the effect of the decrement upon the angle EOI. But such, in this case, are the effects of these decrements, that the edges of the plates applied upon IOA$'$K have the directions $c\,g$, $s\,t$; and those of the plates applied upon EOA$'$H the directions $b\,g$, $r\,t$. For since the lower edge of the first plate applied upon AEOI coincides with bc, and the height of this plate corresponds to that of a single molecule, a little attention will satisfy us that the plane $b\,c\,g$, which on one part coincides likewise with bc, and on the other separates from the base AEOI, by a quantity measured by O g the height of a single molecule, is necessarily parallel to the face produced by the decrement. The same holds with the plane $r\,t\,s$. From this it follows, that if we suppress

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the part situated above rts, we will have a solid on which the face rts will represent the effect of decrement that we are considering.

Now the directions cg, st of the plates applied upon the face IOA′K (and the same may be said of the face EOA′H) in consequence of the auxiliary decrements, are neither parallel to the edge, nor to the diagonal of the face, but intermediate between the one and the other. This want of parallelism will become still greater if we suppose the decrements upon the angle of the base EOI to take place by 3, 4, &c. ranges. This is the kind of decrement to which the name of *intermediate* has been given. It is obvious that it may take place in an infinite number of different directions, according as it deviates more or less from its two limits, the parallelism with the edge, and the diagonal of the face.

Plate CCXXIII. Fig. 4.

In cases similar to those of Fig. 4. we avoid the complication introduced by these intermediate decrements, by supposing them comprehended under the principal decrement. But certain crystals exist, in which all the three decrements round the same solid angle are intermediate. In such a case, the simplest of the three is chosen as the principal decrement, and the other two considered as auxiliary. Fig. 5. represents a case of this kind; cn, which is the edge of the first of the plates applied upon AEOI, is so situated, that on the side of OI there are three molecules subtracted; while on the side OE there is only one: np, which is the edge of the first plate applied upon IOA′K, indicates three molecules subtracted from OI, and two from OA′; cp, which is the edge of the first plate applied upon EOA′H, shews the subtraction of two molecules on OA′, and only one on OE.

Fig. 5.

It is easy to see that the decrements take place relatively to the different faces situated round the angle O, as if the molecules that compose the different plates of superposition, being united invariably several together, compose other molecules of a higher order, and as if the subtraction took place by single ranges of these compound molecules. Thus there will be on the base AEOI a decrement of triple molecules by two ranges in height, since on one part the quadrilateral figure $cOnz$, which represents the base of a compound molecule, is equivalent to the bases of three simple molecules; and, on the other, the line Op, which corresponds to the height of a plate of superposition, is equivalent to the height of two simple molecules. It is easy to conceive, likewise, that the decrement relative to the face EOA′H takes place by two ranges in height of double molecules, because $cOpx$ contains the bases of two simple molecules, and On is equal to the length of three simple molecules. In the decrement which takes place upon IOA′K there is a subtraction of one row of molecules triple in one direction, and double in the other.

Among these three decrements, the one which it appears most natural to adopt as the principal, is the second, which takes place upon the face EOA′H, because it is the one whose direction deviates the least from that of the diagonal EA′; or because it takes place by double molecules, which is a more simple decrement than the other two.

Suppose intermediate decrements on the two lateral angles G, G′ (Fig. 3.) of the face of a rhomboid, and that these decrements take place by ranges of double molecules, that is to say, parallel to the lines um, xy, $u'm'$, $x'y'$. It is evident that these decrements will produce above each rhomb of the primitive nucleus, such as SGg''G′, two faces, which commencing at the angles G, G′, will converge towards each other, and come in contact in a line situated above the diagonal Sg'', but inclined to that diagonal; so that the complete result of the decrement will be the formation of twelve faces disposed six and six towards each summit. Fig. 6. represents one of these solids, with its nucleus inscribed. It is a variety of calcareous spar which sometimes occurs. The lines $a\,b\,a'$ shew the direction of a fracture parallel to the face Gg''G′S of the primitive nucleus. It appears from this Figure that the nucleus does not touch the secondary crystal, except by its lateral angles, which are situated in the edges BS′, Ds', Cs', &c. while in the dodecahedron of Bergman, represented in Figs. 6. and 7, and called by Hauy, *Chaux carbonaté metastique*, the lateral edges of the nucleus coincide with those edges of the secondary crystal that constitute the common basis of the two pyramids, as is evident from inspecting Fig. 7.

Plate CCXXIII. Fig. 6.

Plate CCXXII. Figs. 6, 7.

Hitherto intermediate decrements have been observed only in a small number of instances, but they lead to forms as simple as the other, and give some curious results, which deserve to be studied in a mathematical point of view, without any reference to crystallography.

5. *Compound secondary forms.*

Compound secondary forms.

Simple secondary forms are those which proceed from a single law of decrement, the effect of which covers and conceals the nucleus, which only touches the surface of the secondary crystal by certain angles or edges. *Compound secondary forms* are those which are produced by several simultaneous laws of decrement, or by one law which has not reached its limit, so that faces remain parallel to the original faces of the nucleus, and which concur with the faces produced by decrement, to modify the form of the crystal. Suppose, for example, that the law which produces an octahedron from a cube (described above) should combine with that from which results the dodecahedron with pentagonal faces. (Fig. 12.) The first of these laws would produce eight faces, which would have, for centres, the eight angles of the cubic nucleus. It is easy to see that each of these faces, that, for example, whose centre coincides with the solid angle O, (Fig. 12.) will be parallel to the equilateral triangle, whose sides pass through the points p, s, t. In like manner, the face whose centre coincides with the point O′, will be parallel to the equilateral triangle, whose sides pass through the points s, n, p'. But the second law produces faces situated as the pentagons, cut by the sides of the triangles $p's t$, $s n p'$. Now the section of these triangles upon the pentagon $t\,O\,s\,O'\,n$, reduces the pentagon to an isosceles triangle, which has the line tn for the base, and the two other sides of which pass through the points t, s, and n, s. The same thing takes place with the other pentagons. Hence it follows that the secondary crystal produced will be an icosahedron, bounded by eight equilateral triangles, and 12 isosceles triangles.

Plate CCXXII. Fig 12.

Fig. 7. represents this icosahedron, in which the letters correspond with those of Fig. 12. Plate CCXXII. and shew to the eye the relation between the two solids. But this icosahedron has dimensions much greater than those of the icosahedron which would be obtained by making sections of the eight solid angles of the dodecahedron (Fig. 12.), which are identified with those of the nu-

Plate CCXXIII. Fig. 7.

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cleus. This increase of size was necessary to preserve the size of the nucleus. This will be better understood by the following illustration.

If we wished to obtain the nucleus from the icosahedron of Fig. 7, it is evident that the fractures must be made in directions parallel to the edges *r s*, *t n*, *p q* (Figs. 12. and 7.), so that they should be equally inclined upon the faces of which they form the junction. These planes would pass at the same time through the equilateral triangles *p s t*, *s n p'*, &c. and we would obtain the nucleus when they all met at the centres of the equilateral triangles.

Plate CCXXII. Fig. 12. Plate CCXXIII. Fig. 7.

It follows from this, that the nucleus, the edges of which OI, OE, &c. (Fig. 12.) were uncovered upon the surface of the dodecahedron, is entirely enveloped in the icosahedron (Fig. 7.), excepting its solid angles, which are only points, and which constitute the centres of the equilateral triangles. This being understood, in order to form an accurate idea of the structure of the icosahedron, we must conceive that the plates applied to the nucleus for a certain period undergo decrements only at the angles, as if the secondary solid were to be a regular octahedron. Beyond this term (the decrement on the angles continuing always) a new decrement takes place and combines with the preceding; and this new decrement being relative to the dodecahedron, produces the twelve isosceles triangles. In this manner we see how the nucleus is entirely inclosed in the dodecahedron, excepting the solid angles. The first plates of superposition, which only underwent a decrement on the angles, continued to envelope the nucleus by those portions of their edges which underwent no decrements. It is sometimes necessary to suppose, in this manner, different epochas to the different decrements, which concur to produce a compound secondary form when we wish to give a particular account of the mechanism of the structure.

Plate CCXXIII. Fig. 7. Plate CCXXII. Fig. 12.

From this statement it follows, that the distance between the centres of the equilateral triangles *p t s*, *q t s'* (Fig. 7.), ought to be equal to the corresponding edge OI of the nucleus (Fig. 12.), as it evidently is to the eye, as any one may satisfy himself by inspecting the two Figures.

The icosahedron just described, occurs among the secondary crystals of pyrites. Naturalists at first were disposed to consider this as the regular geometrical icosahedron. But it has been demonstrated by Hauy, that the regular icosahedron does not exist among crystals, and cannot be produced by any law of decrement whatever. The same remark applies to the dodecahedron of mathematicians, a solid bounded by twelve regular and equal pentagons. No such crystal exists, nor can be produced by any law of decrement whatever. Of the five regular solids of mathematicians, the cube, the tetrahedron, the octahedron, the dodecahedron, and the icosahedron, the first three occur in the mineral kingdom, but not the last two.

Plate CCXXII. Fig. 1. Plate CCXXII. Fig. 5.

It will be worth while to give another example of a compound secondary form; and we shall take for that purpose the regular six-sided prism of calcareous spar (Fig. 1.) From the account formerly given of the manner of dissecting this prism, it is easy to conceive that its rhomboidal nucleus AA' (Fig. 5.) has its solid lateral angles E, O, I, K, G, H situated in the middle of the faces of the prisms; from which it follows, that these angles are the points from which the decrements set out that produce these faces.

These decrements act at once upon the three plain angles EOI, EOA', IOA'; but we may satisfy ourselves with considering the decrement relative to one of these angles, supposing the face which results from it extends itself upon the two adjacent rhombs belonging to the same angle. Let us agree, therefore, to restrict the whole to the six angles EOI, EHG, IKG, HGK, OIK, HGO, the three first of which are turned towards the summit A, and the three last to the summit A'. If we suppose a decrement by two ranges of rhomboidal molecules on these different angles, six faces will be produced parallel to the axis, as has been already observed.

Plate CCXXII. Figs. 4, 5.

The plates of superposition, at the same time that they undergo a decrement towards their inferior angles, will extend by their superior parts so as to remain always contiguous to the axis, the length of which will progressively augment. The faces produced by the decrement will gradually increase, and when they touch each other we shall have the solid AA' (Fig. 4.), where each of the faces, as *o* O *o*, is marked by the same letter as the angle O (Fig. 5.), to which it belongs, and which is now situated in the middle of the triangle *o* O *o*, because it constitutes the common point from which the three decrements set out.

In proportion as new plates are applied after this to the preceding ones, the points *o*, *o* rise up, while the point O sinks down, so that at a certain period we shall have the solid represented by Fig. 3, where the faces produced by the decrements are become pentagons, such as *o o i* O *e*.

Plate CCXXII. Fig. 1.

Things being in this state, let us suppose a second decrement to concur with the first, and to take place by a single range upon the superior angle EAI (Fig. 5.), and its opposite angle HA'K, always with this condition, that the face produced by it on both ends of the figure is continued upon the two rhombs adjacent to that to which the angles EAI, HA'K belong. The effect of this decrement will be, to produce two faces perpendicular to the axis; and when it has reached the point at which these faces cut the six faces parallel to the axis, produced by the first decrement, the secondary solid will be completed, and will be a regular six-sided prism (Fig. 1.)

Fig. 2. Fig. 5.

We have already said that this result is general, whatever be the measure of the angles of the primitive rhomboid. We now see why, in the mechanical division of the prism, the cut *p p o o* (Fig. 2.) has its sides *p p*, *o o* parallel to each other, and to the horizontal diagonal EI (Fig. 5.); since the two decrements taking place, the one upon the angles EOI, the other upon the angle EAI, the plates of superposition ought to have their edges turned towards this same diagonal.

In the case which we have been considering, and which is the most usual, the axis of the secondary crystal is longer than that of the nucleus; so that this nucleus having its lateral angles contiguous to the faces of the prism, its summits are inclosed within the prism, at a certain distance above the centre of the bases. If we were to suppose that the two decrements began at the same time, in that case the axis of the prism would be equal to that of the nucleus, and the lateral angles and summits of the nucleus would be tangents, the one to the faces of the prism, the other to its bases. If the decrements on the superior angles of the nucleus were anterior to the other decrements, which is the opposite of the first case, the summits of the nucleus would then be contiguous to the bases of the prism, while its lateral angles would be wholly within the prism, between

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the axis and the prismatic faces. This is the case with certain crystals in which the prism is very short, and resembles an hexagonal plate.

From the preceding account, we see upon what all the different metamorphoses depend, under which the primitive form of crystals presents itself in the secondary forms, whether simple or compound. Sometimes decrements take place at once upon all the edges, as when the rhomboidal dodecahedron is formed from the cube; or upon all the angles, as when the regular octahedron is formed from the cube. Sometimes they take place only on certain edges or certain angles. Sometimes they are uniform, so that only one law exists of decrements by one, two, three, &c. ranges, which acts upon different edges or angles. Sometimes the law varies from one edge to another, or from one angle to another; and this happens chiefly when the nucleus has not a symmetrical form, as when it is a parallelopiped, whose faces differ in the respective inclinations of their faces, or in the measure of their angles. In certain cases, the decrements on the edges concur with those on the angles to produce the same crystalline form. It happens likewise, sometimes, that the same edge, or the same angle, undergoes different laws of decrement, which succeed each other. And, finally, there are a great many cases where the secondary crystal preserves faces parallel to those of the primitive form, and which combine with the faces produced by decrement to modify the figure of the crystal.

If in the midst of such a diversity of laws, sometimes acting solitary, and sometimes in combination, upon the same primitive form, the number of ranges subtracted were likewise very variable; if, for example, there were decrements by 20, 30, 40, or a greater number of ranges of molecules, as is very possible in conception; the multitude of forms which might exist in each mineral species would be sufficient to confound the imagination; and the study of crystallography would present an immense labyrinth, from which, even when assisted by the theory, it would be difficult to extricate one's self. But the force which produces the subtractions appears to have a very limited action. Generally these subtractions take place only by one or two rows of molecules. None have hitherto been observed beyond six rows. But such is the fecundity united with this simplicity, that, supposing we confine ourselves to decrements by one, two, three, and four rows, and exclude those that are mixed or intermediate, we find that the rhomboid is susceptible of 8,388,604 varieties of crystallization. Doubtless many of these varieties do not occur in nature. But there is reason to expect, that discoveries in this field of enquiry will be made in great numbers for a long time to come. Accordingly, many new varieties of crystals have been described since Hauy published his Treatise on the subject; indeed they occur in such abundance, that we can hardly examine a group of crystals without observing varieties that have not yet been described. We are greatly within bounds when we say, that, from the observations already made, it would be possible to at ast double the number of crystals described by Hauy; nor have we reason to believe that the field is in the least degree exhausted. Indeed the number of persons who have turned their attention to crystallography, is much too small to be consistent with a careful survey of the crystals already collected, and deposited in different cabinets.

To have a still more correct idea of the power of crystallization, we must join to that facility which it has of producing so many different forms in setting out from the same form, that of the power which it has of arriving at the same form by different structures. The rhomboidal dodecahedron, for example, which we have seen formed by a combination of cubic molecules, exists likewise in the garnet composed of tetrahedral molecules, with isosceles triangular faces. It occurs also in fluate of lime, where it is composed of regular tetrahedrons. It is even possible for similar molecules, subjected to different laws, to present the same result. Thus the regular six-sided prism, which in calcareous spar exists usually in consequence of a decrement on the inferior angle, is produced sometimes in consequence of a decrement upon the edges adjacent to that angle. Even the primitive form may be produced by a law of decrement. In those species, particularly where the primitive form has a certain symmetry, as when it is a rhomboid, analogies and properties present themselves on all sides. It seems as if geometry could not touch a single term of the immense series of possibles, without leaving the mark of some interesting truth.

The preceding details, we presume, are sufficient to give a general and pretty accurate notion of the formation of those secondary crystals, whose molecules are parallelopipeds. But we have observed above, that there are many species in which the molecules are tetrahedrons or triangular prisms. It will be requisite to make a few observations on the method of proceeding in such cases.

Of Secondary Forms, when the Molecules differ from Parallelopipeds.

Of secondary forms.

It is a character common to all the primitive forms, to be divisible by fractures parallel to their different faces. In the parallelopiped, when it is not joined by some other in a different direction, such a division leads us obviously to the form of a molecule, similar to that of the primitive crystal. In the regular six-sided prism, it gives us for a molecule a triangular equilateral prism. In the octahedron, it appears to produce molecules of two different forms, some by tetrahedrons and octahedrons; the same thing happens with respect to the tetrahedron. Various ideas have been suggested by philosophers to get over the difficulty in this case. Dr Wollaston has got rid of it by supposing the molecules to be spherical, and to produce the tetrahedrons and octahedrons, by combining in fours and sixes. Hauy conceives that the tetrahedron is the integrant molecule, and that the octahedrons are nothing else than empty spaces between the molecules, produced by these molecules uniting by their angles. The subject does not admit of decision; but as it is of no consequence to the theory of crystallography what opinion we adopt, there is no occasion to enter upon the discussion of the subject here. The rhomboidal dodecahedron, when divided in this manner, gives tetrahedrons of isosceles triangular faces, equal and similar to each other.

With respect to the dodecahedron with isosceles triangular faces, we cannot extract its integrant molecules without dividing it in directions different from those which are parallel to the faces. The cutting plains must pass through the axis, and through the edges contiguous to angles of the summit. The molecules obtained are irregular tetrahedrons. The other primitive forms sometimes admit of division in directions

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not parallel to the faces. This is the case with the rhomboid, which constitutes the primitive form of the tourmaline. It may be divided by planes passing through the axis and the oblique diagonals. The result is the production of tetrahedral molecules, such as are represented in Fig. 9.

Plate CCXXII. Fig. 9.

Thus, besides parallelopipeds, there are two other shapes which the integrant molecules assume; namely, the tetrahedron, and the triangular prism. Now, it deserves attention, and it is a point of considerable consequence in the theory of crystals, that the tetrahedral and prismatic molecules are always arranged in such a manner in the interior of primitive and secondary crystals, that, taking them in groups of 2, 4, 6, or 8, they compose parallelopipeds; so that the ranges subtracted by the effect of decrement, are nothing else than these parallelopipeds.

In order to conceive the better how this may be, let us suppose for an instant that the molecules of calcareous spar are divisible into tetrahedrons, as is the case with the rhomboid, which constitutes the primitive form of the tourmaline. This supposition will change nothing in the explanation of the different forms of which calcareous spar is susceptible; that is to say, that in determining the forms of this mineral, aided by the theory, we may always satisfy ourselves with considering decrements by one or more ranges of rhomboidal molecules.

What is only a hypothesis with respect to calcareous spar, is a reality with regard to the tourmaline. But although the rhomboids, to which we arrive by mechanical division in this species, are themselves divisible into tetrahedrons, still the decrements which produce the secondary forms take place by the subtraction of rhomboids similar to the primitive form; so that we may suppose, in the calculations relative to the determination of these forms, that the tetrahedrons which constitute the true molecules are united together in an invariable manner, in each rhomboid.

Let us take another example from those crystals whose primitive form is a regular six-sided prism. Let AD (Fig. 8.) be the base of such a prism, divided into small triangles, which constitute the bases of the integrant molecules. It is evident, that any two neighbouring triangles whatever, such as A *p i*, AO *i*, compose a rhomb, and of course the two prisms to which they belong form by their union a prism with a rhomboidal base, which is a species of parallelopiped. If we conceive that the two triangular prisms, which constitute elements of the parallelopipeds, are invariably united together, it is obvious that we may consider the six-sided prism as composed of rhomboids instead of triangular prisms. Now, if we conceive a series of plates piled upon the hexagon ABCDFG (Fig. 8.), which undergo, for example, upon their different edges, a subtraction of one row of parallelopipeds similar to those that we are supposing here, these edges will successively correspond with the lines of the hexagon *i l m n r h*, *k u x y g e*, &c.; from which we see, that the quantity that each plate passes the other is a sum of parallelopipeds or prisms with rhomboidal bases; and it is easy to judge, that the result of the decrement, supposing it to reach its limit, will be a right hexangular pyramid, which will have for its base the hexagon ABCDFG.

Plate CCXXII. Fig. 8.

All the other primitive forms different from the parallelopiped, give analogous results. We might even substitute for each of these forms a nucleus similar to the little parallelopipeds, which are formed by the union of the tetrahedrons or triangular prisms, and we would succeed equally in explaining the secondary forms by laws of decrement applied to that nucleus, which would be obtained likewise by mechanical division.

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The Abbé Hauy, to whom we are indebted for the whole theory of crystals, calls these parallelopipeds, composed of tetrahedrons or triangular prisms, *subtractive molecules*. They are always substituted in place of the tetrahedrons or triangular prisms, in considering the decrements which produce the secondary forms in these cases. Thus, as far as the theory of crystals is concerned, we have nothing to do with the integrant molecules, but may conceive all crystals composed of a congeries of parallelopipeds.

Though we have extended this Chapter to a considerable length, there is still another particular which requires explanation, before we proceed to the mathematical theory. The Abbé Hauy has invented particular symbols to denote the particular laws of decrement which produce the secondary forms. As these symbols occur constantly in his writings, and as they are useful, by greatly shortening the account of the formation of secondary crystals, it is proper they should be understood. We shall endeavour, therefore, to explain them in this place.

Hauy's symbols. Plate CCXXIII. Fig. 8.

Let Fig. 8. represent an oblique parallelopiped, the faces of which have angles with different measures, and let it be the primitive form of some mineral; as, for example, of felspar.

The vowels are adopted to represent the solid angles. The four first, A, E, I, O, are placed at the four angles of the superior base following the order of the alphabet, and that of ordinary writing, namely, beginning at the top, and going from left to right.

The consonants are chosen to denote the edges. The six first, B, C, D, F, G, H, are placed on the middle of the edges of the superior base, and upon the two longitudinal edges of the lateral faces, which occur first in going from left to right. These consonants are likewise arranged in the alphabetical order, and according to the usual mode of writing.

The letters P, M, T, which are the initials of the syllables of which the word *primitive* is composed, are placed each in the middle of the superior base, and of the two lateral faces exhibited to view.

Each of the four solid angles, or of the six edges marked by letters, is susceptible in the present case, on account of the irregular form of the parallelopiped, of undergoing particular laws of decrement. Hence the reason why they are marked each with a different letter. But as the laws of decrement act with the greatest symmetry possible, every thing which takes place with respect to the angles and edges marked with letters, takes place also with respect to the opposite angles and edges which are not marked, or are not visible. It was only necessary to mark the number of solid angles or edges which undergo distinct decrements, because these decrements include likewise implicitly all those which take place upon analogous angles or edges.

In some cases, however, it is necessary to indicate these last angles or edges. In such cases, the small letters, having the same names as the capitals, are employed for the purpose. The angles analogous to A, E, I, O, are denoted by *a, e, i, o*; and the edges analogous to B, C, D, F, G, H, are denoted by *b, c, d, f, g, h*. But it is very seldom necessary to mark these small letters on the Figure; it is sufficient to introduce them

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into the symbol of the crystal, because it is easy to conceive the place which every one ought to occupy in the Figure.

To indicate the effects of decrements by one, two, three, four, or more ranges in breadth, the figures 1, 2, 3, 4, &c. are employed in the way to be immediately explained; and, to indicate the effects of decrements by 2, 3, &c. ranges in height, the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c. are employed.

The three letters P, M, T, serve to distinguish either the form of the nucleus, without any modification, when they alone constitute the symbol of the crystal, or the faces parallel to those of the nucleus, in the case where the decrements do not reach their limit; and then these letters are combined in the symbol of the crystal with those which relate to the angles or edges that have undergone decrements.

Let us suppose at first, for the greater simplicity, that one of the solid angles, such as O, is intercepted by a single additional face. The decrement which produces this face may take place either on the base P, or on the face T, which is on the right of the observer; or on the face M, which is on the left. In the first case, the figure marking the decrement is placed above the letter O; in the second case, the figure is placed like an ordinary exponent; in the third case, it is placed on the left side, and somewhat above the letter.

Thus, $\overset{2}{O}$ denotes the effect of a decrement by two ranges in breadth, parallel to the diagonal of the base P, which passes through the angle E. O^3 indicates the effect of a decrement by three ranges in breadth, parallel to the diagonal of the face T, which passes through the angle I. ^4O indicates the effect of a decrement by four ranges in breadth, parallel to the diagonal of the face M that passes through the angle E.

When the decrement relates to some one of the three other solid angles I, A, E, the observer is conceived to move round the crystal till he is opposite to that angle, as he is naturally opposite to the angle O in the case which we have been describing; or, which comes to the same thing, he is conceived to turn round the crystal till the solid angle that he is considering be exactly opposite to him, and it is relative to that position that a decrement is said to take place towards the right or towards the left.

Plate CCXXIII. Fig. 8, 9.

For example, if we are speaking of the solid angle A, the sign A^2 will represent the effect of a decrement by two ranges on the surface AE *s r* (Fig. 9.), or upon that which is opposite to T (Fig. 8.); and ^3A will represent the effect of a decrement by three ranges upon the face AI *u r* (Fig. 9.), or upon that which is opposite to M (Fig. 8.)

As to the decrements on the edges, those which take place towards the boundary BCFD of the base, are expressed by a number placed above or below the letter, according as their effect takes place in going up or going down, supposing them to set out from the edge to which they are referred; while those which take place on the longitudinal edges G, H, are indicated by an exponent placed on the right or the left of the letter, according as they take place in one direction or the other. Thus $\overset{2}{D}$ expresses a decrement by two ranges proceeding from D towards C; $\overset{3}{C}$ a decrement by three ranges going from C towards D; $\underset{2}{D}$ a decrement by two ranges, descending upon the face M; ^3H a decrement by three ranges, proceeding from H towards G; ^4G a decrement by four ranges, proceeding from G towards the edge opposite to H, &c.

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Plate CCXXIII. Fig 8, 9.

When it is necessary to denote by a small letter, such as *d*, a decrement upon the edge *u r* (Fig. 9.), opposite to the edge denoted by the capital letter D (Fig 8.), we must suppose the crystal turned upside down. Hence $\overset{2}{d}$ will express a decrement by two ranges upon the base *p*, just as $\overset{2}{D}$ expresses a similar decrement on the base P. For the same reason, $\overset{3}{c}$ will express a decrement by three ranges, proceeding from *s p* towards EO (Fig. 9.)

If the same solid angle, or the same edge, undergo several successive decrements on the same side, or different decrements which take place on different sides, in that case, the letter pointing out the angle or edge is repeated as often as the decrements, varying the figure each time, to make it correspond with the particular decrements pointed out. Thus $\overset{2}{D}$ $\underset{3}{D}$ will denote two decrements upon the edge D, one of two ranges upon the base P, another of three ranges upon the face M. ^2H ^4H will denote two decrements, the one by two ranges, the other by four, on the left of the edge H.

Mixed decrements are marked according to the same principles, employing the fractions $\frac{2}{3}$, $\frac{3}{4}$, &c. which represent them; the numerator referring to the decrements in breadth, and the denominator to decrements in height.

Fig. 8. 10.

The method of describing the intermediate decrements still remains to be explained. This will be best done by an example. Let AEOI (Fig. 10.) be the same face as in Fig. 8. Let us suppose a decrement by one range of double molecules, according to lines parallel to *x y*, so that O *y* measures the double length of a molecule, and O *x* lines equal to that of a single molecule. This kind of decrement is written in this manner, ($\overset{1}{O}$ D^1 F^2). The parenthesis lets us know, in the first place, that the decrement is intermediate; $\overset{1}{O}$ indicates that it takes place by one range upon the angle marked by that lettter, and that it belongs to the base AEOI (Fig. 8.) D^1 F^2 indicate that there is one length of a molecule taken away along the edge D, and two lengths along the edge F.

It is useful to have a language to denote these symbols, so that they may be easily written down when dictated by another person. On that account, we shall mention here the mode followed by Hauy for that purpose. The symbols O^2, ^3O, are thus read: O *two on the right*, O *three on the left*, $\overset{2}{O}$, $\underset{4}{O}$ thus, O *under two*, O *above four*. Finally, the symbol ($\overset{1}{O}$ D^1 F^2) thus, *in a parenthesis*, O *under one*, D *one*, F *two*.

We must now notice the order in which these letters must be placed, in order to denote a secondary crystal. If the alphabetical order were adopted, there would result a sort of confusion in the picture which the formula presents. It is more natural to conform to the order which would direct an observer in the description of the crystal; that is to say, to begin with the prism or the middle part, and to indicate its different faces as they present themselves successively to the eye, then to pass to the faces of the summit or the pyramid.

Fig. 8. 11.

Suppose, now, that Fig. 11. represents the variety of felspar called *bibinaire* by Hauy, the primitive form of which is seen in Fig. 8. In this variety, the face *l* (Fig. 11.) results from a decrement by two ranges on the edge G, (Fig. 8.) going towards H. The face M (Fig. 11.) corresponds with that which is marked with the same letter in Fig. 8. and which is only concealed

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Plate CCXXIII. Fig. 8. 11.

in part by the effect of the decrement. The face T (Fig. 11.) is parallel to T (Fig. 8.) The pentagon x (Fig. 11.) comes from a decrement by two ranges on the angle I (Fig. 8.) parallel to the diagonal AO. As this decrement does not reach its limit, the summit exhibits a second pentagon P (Fig. 11.) parallel to the base P (Fig. 8.) All this description may be exhibited in symbolic language as follows: $G^2\,M\,T\,\overset{2}{I}\,P$.

In order to prevent beginners from finding any thing ambiguous in this symbolical mode of writing, especially in complicated cases, Hauy is in the habit of placing under the different letters which compose the symbol, those which correspond to them in the figure. If we adopt this mode, which is a considerable improvement, the symbol denoting *bibinaire* felspar will be as follows:

$$\begin{array}{ccccc} G^2 & M & T & \overset{2}{I} & P. \\ l & M & T & x & P. \end{array}$$

These letters thus written below, enable us to compare the symbol with the figure, and thus to decypher the meaning with facility, how complicated soever it should be. But some more observations will be necessary, in order to understand fully the way in which Hauy employs these symbols.

Let us now then turn our attention to parallelopipeds of a more regular form than that which constitutes the primitive crystal of felspar. But let us suppose them at first not to be rhomboids. They are nothing else than what is represented in Fig. 8. but the form has varied so as to render them symmetrical. In consequence of this alteration, certain angles and edges which differed from each other in the first parallelopiped, have become equal in this. Hence, every thing that takes place on one of them is repeated on the other. They ought therefore to be denoted by the same letter. Thus, in algebra, certain general solutions are simplified in particular cases, when a quantity at first supposed to be different from another becomes equal to it.

Let us suppose, for example, that the primitive form is a rectangular prism, having oblique angled parallelograms for its bases, one side of which is longer than the other. In that case, we have O=A (Fig. 8.), I=E, &c. In such a case, the first letter of the alphabet will be substituted for the other, as is done in Fig. 12.

If we pass through the different kinds of parallelopipeds, we shall find them acquire different degrees of simplicity, which occasions new equalities in the angles and edges, and of course new substitutions of letters. We shall have successively,

The oblique prism with rhomboidal bases represented in Fig. 13.

The rectangular prism, with rectangular bases, represented in Fig. 14.

The rectangular prism, with rhomboidal bases, represented in Fig. 15.

The rectangular prism, with square bases, represented in Fig. 16.

The cube represented in Fig. 17. Here only the superior base is marked with letters, because what takes place with respect to it may be applied indifferently to any of the other faces.

The same mode is followed in writing the symbols for these different forms, only the letters that have the same name and the same figures, are not repeated.

Fig. 18. An example will render the method evident. Fig. 18. represents the most common variety of the *cymophane*, the nucleus of which is a rectangular parallelopiped, such as is represented in Fig. 14. The symbol of the secondary crystal will be

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$$\begin{array}{ccccccc} M & T & {}^2G & G^2 & \overset{1}{B} & A^{\frac{3}{2}} & {}^{\frac{3}{2}}A. \\ M & T & & s & i & o & \end{array}$$

Hauy has called this variety annular cymophane.

To understand the preceding expression better, let us mark each angle and edge with a particular letter, as if the parallelopiped were oblique angled. See Fig. 19. In that case the symbol would become $MT\,{}^2G\,H^2\,\overset{1}{B}\,\overset{1}{F}\,E^{\frac{3}{2}}\,{}^{\frac{3}{2}}O$. But if we compare Fig. 19. with Fig. 14. we see that H=G, F=B, O=A, &c. Hence, if we substitute, instead of the first letters, their values, we get $MT\,{}^2G\,G^2\,\overset{1}{B}\,\overset{1}{B}\,A^{\frac{3}{2}}\,{}^{\frac{3}{2}}A$, which becomes the same with the one given above, when the useless repetition of $\overset{1}{B}$ is suppressed.

Plate CCXXIII. Fig. 19.

From the preceding statement, it is evident that we must take care not to confound, for example, ${}^2G\,G^2$ with $G^2\,{}^2G$. The first symbol indicates the decrements which take place on the face T (Fig. 14.) and on the face opposite to it, going from the edges G towards those that correspond with them behind the parallelopiped. The second indicates the decrements which take place upon the face M, and which meet each other in the middle of that face. If these two decrements took place simultaneously, their symbol would be ${}^2G^2$.

In the preceding symbols, each letter, such as ${}^2G$ or G^2 can only be applied to a single edge, situated to the right or the left, as that letter itself. But ${}^2G^2$ applies indifferently to the one edge or the other. Hence, it is needless to repeat that letter.

Let us take the Figure 20. as another example.* If we suppose Fig. 15. to represent its primitive form, we will have for the symbol of the variety of crystal here represented, Fig. 20.

$$\begin{array}{ccccccc} {}^3G^3 & M & \overset{2}{B} & \overset{3}{B} & \overset{1}{E} & \overset{2}{E} & P \\ o & M & r & s & z & u & P \end{array}$$

In this symbol ${}^3G^3$ indicates two distinct faces formed on each side of each edge G. But it is not necessary to place two letters under that symbol, because all the faces situated in the same manner being distinguished by the same letter in the figure, it is sufficient to point out that the symbol ${}^3G^3$ applies to the faces marked with the letter *o*, and this requires only to write the letter *o* once under the symbol.

From the same principles, it follows, that the rhomboidal dodecahedron derived from the cube, (Fig. 17.) is expressed by the symbol $\overset{1}{B}\,\underset{1}{B}$. The octahedron derived from the cube is expressed thus, $\overset{1}{A}\,{}^1A^1$.

The rhomboid, supposing it placed in the most natural aspect, that is to say, so that the two solid angles composed of three equal plane angles, are in the same vertical line, has properly speaking no base, but merely summits, which are the extremities of its axis. Its angles and edges are marked as in Fig. 21. The letter *e* denotes that the angle marked by it is similar to that which is marked with a capital E. So that if all the lateral angles were indicated by letters, the three nearest the superior summit would have the letter E, and the three nearest the inferior summit the letter *e*.

As the rhomboid has its six faces equal and similar, it is only necessary to consider the decrements relative

* This Figure represents a variety of the topaz; of course, our supposition respecting the primitive crystal is not accurate. But that does not injure the illustration.

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to one of these faces; as, for example, the one which in the Figure is marked P, because all the others are mere repetitions of this. These observations suggest the following rules: 1. The decrements which set out from the superior angle A, or the superior edge B, will have the figure indicating the number of ranges placed below A and B. 2. Those which set out from the lateral angles E will have their figures situated at the side and towards the top of the same letter. 3. With respect to those which set out from the inferior angle *e*, or from the inferior edge D, the figure will be placed above the letter *e* or D.

PLATE CCXXIII. Fig. 22.

Suppose, for example, that Fig. 22. represents the variety of calcareous spar, called *analogic* by Hauy, its symbol will be $\overset{2}{e}\ \overset{2}{\mathrm{D}}\ \underset{1}{\mathrm{B}}$.

$$\begin{matrix} c & r & g \end{matrix}$$

What has been said of the rhomboid is easily applied to the other primitive forms. But probably some illustrations will be considered as necessary to make the symbols applied to them the more readily understood. On that account we shall take a short review of each of them.

Figs. 23, 24, 25.

Fig. 23. represents the octahedron with scalene triangles, Fig. 24. the octahedron with isosceles triangles, and Fig. 25. the regular octahedron.

In placing the figures which accompany the letters in the symbols, the same rule is followed that was described with respect to the rhomboid. Thus, in Fig. 24. the figure is placed below the letter to represent decrements setting out from the angle A or the edge B; it is placed above for those which set out from the edge D, and at the side for those which set out from the angle E. If we want to denote the result of a decrement by one range upon all the angles of the regular octahedron (Fig. 25.) we have only to write $\overset{1}{\mathrm{A}}\,{}^{1}\mathrm{A}^{1}$. To indicate the result of a decrement by one range on all the edges, we write $\underset{1}{\mathrm{B}}\ \overset{1}{\mathrm{B}}$. The first of these decrements produces a cube, the second a rhomboidal dodecahedron.

In some species, as in the nitrate of potash, the primitive octahedron, the surface of which is composed of eight isosceles triangles, similar 4 and 4 to each other, ought to have the position represented in Fig. 26. that the secondary crystals may have the most natural attitude, that is to say, that the edges which join the two pyramids which compose the octahedron, ought to be two of them in a vertical direction, as F, and two in a horizontal, as B. By comparing Fig. 26. with Fig. 27. in which the letters are placed as if all the angles and edges had different functions, it will be easy to conceive the distribution adopted in Fig. 26. and brought to the symmetry of the true primitive form. For, in the present case, we have E=A, D=C, G=F.

Figs. 26, 27.

The figure denoting the number of ranges, will be placed under the letter, to denote decrements proceeding from B. It will be placed at one side, or below, to denote those proceeding from A; according as their effect respects the triangle AIA, or the triangle AIF. It will be placed above or below, for those which proceed from C, according as their effect is produced on the first or the second of these triangles. It will be placed at one side for the decrements which proceed from F. Finally, it will be placed above, below, or on either side, for the decrements that proceed from I, according as their effect takes place towards B or towards F.

The tetrahedron being always regular, when it becomes the primitive form, it will be expressed as in Fig. 28. To indicate, for example, a decrement by three ranges on all the edges, we would write $\underset{3}{\mathrm{B}}\ \overset{3}{\mathrm{B}}$; and to indicate a decrement by two ranges upon all the angles, we would write $\underset{2}{\mathrm{A}}\,{}^{2}\mathrm{A}^{2}$, as in the case of the regular octahedron.

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PLATE CCXXIII. Fig. 28.

A simple inspection of Fig. 29. is sufficient to make us understand the symbols in the case of regular six-sided prisms. The figures are written precisely in the manner already decribed for the four-sided prism; to which, therefore, we refer the reader. But it happens sometimes that three of the solid angles taken alternately are replaced by faces, while the intermediate angles remain untouched. In that case the prism is distinguished as in Fig. 30.

Fig. 29.

Fig. 30.

In the rhomboidal dodecahedron (Fig. 31.) each solid angle composed of three planes may be assimilated to a summit of the obtuse rhomboid. Hence, it is only necessary to give letters to one face, as may be seen in the Figure.

Fig. 31.

Hitherto there has been no occasion to use any symbols for the dodecahedron with triangular faces, because it is more natural to substitute in place of it the rhomboid from which it is derived, and which gives simpler laws of decrement.

We have still to explain the method of representing a peculiar case, which sometimes occurs in some crystals, where the parts opposite to those which undergo certain decrements remain untouched, or are modified by different laws. This case belongs chiefly to the tourmaline, and it is easy to indicate its peculiarity by means of zeros.

For example, in the variety of tourmaline represented in Fig. 33. the primitive form of which is represented in Fig. 32.; the prism, which is nine-sided, has six of its faces, namely, *s*, *s* (Fig. 33.) produced by the subtraction of one range upon the edges D, D (Fig. 32.) and the three others, such as *l*, by the subtraction of two ranges on the three angles *e* (Fig. 32.) only. Farther, the inferior summit has only three faces parallel to those of the nucleus; while, on the superior summit, the three edges B are replaced each by a face *n*, *n* (Fig. 33.) in consequence of a decrement which has not reached its limit. This crystal is represented by the following symbol: $\overset{1}{\mathrm{D}}\ \overset{2}{e}\ \overset{2.0}{\mathrm{E}}\ \mathrm{P}\ \underset{1}{\mathrm{B}}\ \underset{1.0}{b}$. The quantities

Figs 32, 33.

$$\begin{matrix} s & l & & \mathrm{P} & n \end{matrix}$$

${}^{2.0}\mathrm{E}$, $\underset{1.0}{b}$ indicate, the one that the angles E (Fig. 32.) opposite to *e* undergo no decrement; the other, that the edges parallel to B remain equally untouched.

If these edges underwent a different law, which produced, for example, an abstraction of two ranges, the symbol would become $\overset{1}{\mathrm{D}}\ \overset{2}{e}\ \overset{2\ 0}{\mathrm{E}}\ \mathrm{P}\ \underset{1}{\mathrm{B}}\ \underset{2}{b}$. From this, it is obvious, that it must be understood that the decrements represented by a capital letter accompanied by any figure, do not implicitly include the similar decrements represented by a small letter of the same name, or the opposite, that is to say, that $\overset{2}{\mathrm{B}}$ does not implicitly include $\underset{2}{b}$, or *vice versa*, except when the second letter does not enter into the symbol with a different figure, or does not bear the same figure accompanied by a zero. In the first case, each of the two letters indicates a decrement which is peculiar to the edge or angle in-

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dicated by it. In the second case, the zero indicates that the angle or edge to which it exclusively relates undergoes no decrement whatever. Thus, in the symbol $\overset{1}{D}\,\overset{2}{e}\,\overset{2.0}{E}\ P\ \underset{1}{B}\ \underset{2}{b}$, $\underset{1}{B}$ expresses a decrement by one range, which takes place only on the edges contiguous to the superior summit A (Fig. 32.); $\underset{2}{b}$ indicates a decrement by two ranges, which only takes place on the edges contiguous to the inferior summit. The quantities $\overset{2}{e}$ and $\overset{2.0}{E}$ ought likewise to be considered independent of each other. The first indicating a decrement of two ranges on the angles *e* only, and the second indicating that no decrement whatever takes place upon the angles E, opposite to the preceding.

The preceding observations have been given in considerable detail, in order to put our readers completely in possession of the method, and to enable them to make a figure of a secondary crystal, merely from the symbol representing the laws of its formation. But to enable any person to read these symbols, and to understand them, much briefer directions would have sufficed. We shall subjoin the following rules, which will be sufficient for that purpose, and which will serve as a kind of epitome of the preceding observations:

General rules for understanding the symbols.

1. Every vowel employed in the symbol of a crystal indicates a solid angle, marked with the same letter in the figure which represents the nucleus. Every consonant indicates the edge which has the same letter in the figure.

2. Each vowel and consonant is accompanied by a figure, the value and position of which indicates the law of decrement which the corresponding angle or edge undergoes. We must except the three consonants P, M, T; each of which, when it appears in the symbol of a crystal, indicates that the crystal has faces parallel to those faces which have the same letters on the figure of the nucleus.

3. Each letter contained in the symbol of a crystal, is understood, with the figure belonging to it, to apply to all the angles or edges which have the same function as it in the figure, and is marked with the same letter.

4. Every number joined to a letter indicates a decrement, setting out from the angle or the edge denoted by that letter. If the number is a whole number, it indicates how many ranges in breadth are subtracted, supposing each plate to have only the thickness of one molecule. If the number is a fraction, the numerator indicates the number of ranges subtracted in breadth, and the denominator the number of ranges subtracted in height.

5. According as the number is placed below or above the letter which it accompanies, it indicates that the decrement descends or ascends, setting out from the angle or edge marked by the letter. If it is placed towards the top, and either on the right or the left side of the letter, it indicates a decrement in a lateral direction, either to the right or to the left of the angle or edge marked by the letter.

6. When a letter is twice repeated, with the same number placed on two different sides, as $^{2}G\,G^{2}$ or $G^{2}\,^{2}G$, $^{2}A\,A^{2}$ or $A^{2}\,^{2}A$, the two edges, or the two angles which it marks, ought to be considered on the figure in the same relative positions; that is to say, for example, that in the symbol $^{2}G\,G^{2}$, the quantity ^{2}G indicates the effect of decrement on the edge G situated at the left, and the quantity G^{2} the effect of decrement upon the edge situated at the right.

7. When a letter has the same number both on the left and the right side, as $^{3}G^{3}$, it applies equally to all the edges G. The same thing holds with the letters which belong to the angles.

Goniometers.

8. The parenthesis, as for example ($\overset{3}{O}D^{1}\,F^{2}$), indicates an intermediate decrement. The letter $\overset{3}{O}$ indicates, in the first place, that the decrement takes place by three ranges on the angle O, and that its effect is ascending. $D^{1}\,F^{2}$ indicate, that for one molecule subtracted along the edge D, there are two molecules subtracted along the edge F.

9. Every small letter occurring in the symbol of a crystal, indicates the angle or the edge diametrically opposite to that which has the capital letter of the same name in the figure, where the small letter is omitted as superfluous. We must except the letter *e*, which is always employed in the rhomboid, and which indicates, according to the principle, the angle opposite to that which bears the letter E.

10. When a symbol contains two letters of the same name, the one large the other small, with different numbers attached to them, the two opposite edges or angles to which these letters belong, are conceived to undergo each exclusively the law of decrement indicated by the number attached to the letter.

11. Every letter, whether large or small, marked by a number having a zero following it, indicates that the decrement denoted by that number does not take place on the particular edge or angle denoted by the letter.

Goniometers for measuring the angles of crystals.

As the whole theory of crystallization depends upon the knowledge of the angles which the different faces of the crystal make with one another, it is necessary to be in possession of instruments for measuring these angles. Such instruments are known by the name of Goniometers. The goniometer first employed is exhibited in Fig. 34. The way in which it is used must be obvious without much description. It consists of a semicircle of brass, divided into degrees. At its centre *c* is fixed a pin, upon which slide the two arms AB and GF. The last of these GF, by means of a screw, may be fixed in any position, so that the distance between the end G and the centre, may correspond with the face of the crystal to be measured. The other arm AB is drawn up, till the distance between B and the centre corresponds as nearly as possible with the size of the other face of the crystal. It is then turned round, till the angle of the crystal to be measured corresponds exactly with the angle B*c*G; the arm AB then cuts the semicircle in the angle which corresponds with that of the crystal. There is a hinge upon the middle of the brass semicircle, which is not seen in the figure. By means of it, one-half of the semicircle may be thrown back, when the crystal to be examined happens to be so situated in a group, that the arms could not otherwise come at it.

PLATE CCXXIII. Fig. 34.

Romé de Lisle's and Hauy's goniometers.

This was the only goniometer used by Romé de Lisle, and Hauy, when he published his Treatise on Mineralogy, in 1801. It can scarcely be depended on nearer than two or three degrees; or when the faces of the crystals are large and very smooth, perhaps a very steady hand, accustomed to handle the instrument, may come within one degree. On that account, the surprizing accuracy of many of Hauy's measurements reflects the greatest credit both on his care and his sagacity. It is true, indeed, that all his measurements are ultimately fixed by the application of his mathematical theory. But the original data of that theory itself are derived from the goniometrical measurement of angles. We

Goniometers.

see, from the mistake into which he has fallen in the case of calcareous spar, that not even the most seducing and numerous mathematical analogies are to be relied on in all cases. For nothing can be more conclusive in appearance, than his reasons for fixing upon a particular angle for the inclination of the faces in this crystal, yet they have led him to an inaccurate conclusion. Hence it would not be at all surprizing, if the measures which he assigns for a very considerable number of his primitive forms, should turn out ultimately nothing more than approximations.

Dr Wollaston's goniometer.

It was an object of great importance, therefore, to get a goniometer capable of measuring with a greater degree of accuracy. Dr Wollaston, to whose mechanical inventions the philosophical world lies under such obligations, has contrived one upon optical principles, susceptible of as great a degree of accuracy as is thought requisite. The original instrument of Dr Wollaston only measures angles within five minutes of the truth; but we have seen the same instrument made so as to come within half a minute; and Malus, by converting it to a repeating circle, has made it susceptible of as much accuracy as the experimenter chuses. But the truth is, that in the greater number of crystals it is not possible to measure the angles with perfect accuracy, from some imperfection in the crystal itself. The faces are often rough, and do not reflect the light equally. The best crystals for measuring with Dr Wollaston's goniometer, are those which are very small. When they are very small, and transparent, with smooth faces, we may arrive at any degree of precision we think proper.

Plate CCXXIV. Fig. 1.

Fig. 1. represents Dr Wollaston's goniometer, as originally constructed. It consists of a brass circle, graduated on its edge, and mounted on a horizontal axle, supported by an upright pillar. This axle being perforated, admits the passage of a smaller axle through it, to which any crystal of a moderate size may be attached by a piece of wax, with its edge, or intersection of the surfaces, horizontal and parallel to the axis of motion. This position of the crystal is first adjusted, so that, by turning the smaller axle, each of the two surfaces, whose inclination is to be measured, will reflect the same light to the eye. The circle is then set to zero, or to 180°, by an index attached to the pillar that supports it. The small axle is then turned, till the further surface reflects the light of a candle (or the bar of a window) to the eye; and, lastly, the eye being kept steadily in the same place, the circle is turned by its larger axle till the second surface reflects the same light. This second surface is thus ascertained to be in the same position as the former surface had been. The angle through which the circle has moved, is, in fact, the supplement to the inclination of the surfaces; but as the graduations on its margin are numbered accordingly in an inverted order, the angle is correctly shewn by the index without need of computation. The best way of using the instrument, is to place the eye within about an inch of the face of the crystal, and to turn it by means of the small axle, till a bar of the window, or some other distant object, be brought exactly to correspond with the bottom of the window. You then turn the circle till the other face is in the same position. The index now points out the size of the angle measured.

In Fig. 1, *a b* is the principal circle of the goniometer, graduated on its edge; *c c* the axle of the circle; *d* a milled head, by which the circle is turned; *e e* the small axle for turning the crystal without moving the circle; *f* a milled head on the small axle; *g* a brass plate supported by the pillar, and graduated as a vernier to every five minutes; *h* the extremity of a small spring, by which the circle is stopped at 180°, without the trouble of reading off; *i i* and *k k* are two centres of motion, the one horizontal, the other vertical, for adjusting the position of the crystal; one turned by the handle *l*, the other by the milled head *m*.

The crystal being attached to a screw-head at the point *n* (in the centre of all the motions), with one of its surfaces as nearly parallel as may be to the milled head *m*, is next rendered truly parallel to the axis by turning the handle *l*, till the reflected image of a horizontal line is seen to be horizontal. By means of the milled head *f*, the second surface is then brought into the position of the first; and if the reflected image from this surface is found not to be horizontal, it is rendered so by turning the milled head *m*; and since this motion is parallel to the first surface, it does not derange the preceding adjustment. See *Phil. Trans.* 1809, Part II.

Dr Brewster's goniometer. Plate CCXXIV. Fig. 2.

Another goniometer, upon optical principles, has likewise been invented by Dr Brewster. Fig. 2. exhibits a view of this goniometer. AB is a circle about six inches in diameter, divided into 360°. It moves round OO as a centre, and is supported by two upright bars M, N, fixed with screws into the stand SS. To the ring OO, supported by these bars, is fixed the arm G, that carries the vernier scale E. This scale remains stationary, while a rotatory motion is communicated to the divided circle AB, by means of a pinion moved by the milled head Q, which works in the teeth cut upon the circumference of the circle AB. A rectangular piece of brass L is fixed by two screws to one of the radii R of the graduated circle, so that the slider *s s* may move upon it, and be placed at different distances from the centre of motion, by laying hold of the pin below *s*. A thin plate *b c*, forming part of the cock *t b c* C on the top of this slider, carries the crystal, and by means of its projecting extremity *b* this plate has a motion round the screw *c*, in a plane perpendicular to that of the divided circle. Below this is another plate, which is seen at *a*, and which may be raised and depressed round an axis, one end of which appears at *x*, by turning the screw *t*, which works in the plate below *a*. Below the plate *a*, and fixed to it by the screw C, is another piece of brass fastened to the top of the slider by the screw above C, and moveable, by means of the lever *t*, round that screw as a centre, in the same plane with the circle. When the handle *b* is employed to move the plate *b c*, it is pushed to or from the plane of the circle AB. When the lever *t* is used to give the whole cock *b c* C a rotatory motion about the screw C, it is moved in a plane parallel to that of the circle AB; but when *t* is used to raise or depress the plates *b c*, and *a*, it is turned round like a screw. By the combination of these motions, the common section of the surfaces of the crystals is brought into a position parallel to the axis of the instrument. This adjustment is effected by placing the graduated circle in such a position, that a vertical window bar, or any other straight line, is nearly in the plane of the circle. A motion of rotation is then given to the crystal by the lever *t*; and if the reflected image of the window bar forms one straight line with the object itself, when examined in each surface of the crystal, the adjustment is complete, or the plane of the graduated circle is parallel to a plane at right angles to the edge or common section of the surfaces of the crystal. The instrument is then placed in such a position, that the plane passing through the eye and the window bar is perpendicular

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to the plane of the divided circle, or that the edge or common section of the surfaces of the crystal, points to the bar of the window, the index is set to the beginning of the scale by means of a stop at the 180th degree, and the image of the vertical window bar, or any rectilineal object formed by reflection from the first or right hand surface of the crystal, is brought to coincide with the direct image by the vertical motion of the cock. The whole graduated circle is then made to revolve by the toothed pinion, till the reflected image of the vertical bar again coincides with the direct image when examined in the other surface of the crystal. When this position is obtained, the index of the vernier will point out, on the divided arch, the angle of the crystal. In order that the instrument may be used merely when held in the hand, a vertical frame HK is attached to it by the arm DH, and the parallel silver wires stretched across it are used instead of the window bar. See the article GONIOMETERS; and Brewster's *Treatise on New Philosophical Instruments*, p. 89.

We have never had an opportunity of seeing any description of the repeating goniometer of Malus. But it is easy to see how the goniometer of Wollaston might be made a repeating circle. In most cases, however, the use of such an instrument implies a degree of accuracy which cannot be attained in the mensuration of the angles of crystals.

CHAP. II.

Mathematical Theory of the Structure of Crystals.

Mathematical theory.

IN the preceding Chapter we have given a popular view of the structure of crystals, which we conceive will be easily understood by any attentive reader, even though he should not be conversant with mathematics. If we were to confine ourselves to this popular view of the subject, however, this article would have little utility, because it would be out of the power of readers to judge of the accuracy of the principles which have been laid down, or to understand how these principles were discovered. Far less would they be able to prosecute the subject themselves, to investigate the structure of new crystals, and to carry the theory of crystallization to a state of perfection. To bring this valuable branch of knowledge within their power, is the object of the present Chapter.

The whole mathematical theory of crystals belongs to the Abbé Hauy. For what has been done by others is, comparatively speaking, so trifling, that we may overlook it altogether. He has prosecuted the subject with indefatigable industry for more than 30 years. His first essays on it, appeared in the Memoirs of the French Academy. He afterwards published an Essay on the subject, in which he developed the mathematical theory. From that period to the year 1801, numerous papers of his appeared in the *Journal de Mines*, investigating the crystals belonging to different species of minerals. In the year 1801, his *Traité de Mineralogie* appeared. In this work he has inserted a complete view of the subject, so luminous and well arranged, that we shall have little more to do than to extract the essential parts of that treatise, unless there happen to be one or two cases in which subsequent improvements have been made. We ought to mention, that since the year 1801, numerous papers on the same subject have appeared in the *Journal de Mines;* and the *Annales de Museum d'Histoire Naturelle,* drawn up by the Abbé Hauy, and containing much new and valuable matter. Count Bournon has likewise published an important work on calcareous spar, in which he has given a theory of crystallization of his own, which has been animadverted on in a masterly manner by the Abbé Hauy, in one of the numbers of the *Annales de Museum d'Histoire Naturelle.* We are not aware that any thing has been published in Great Britain upon the mathematical theory of crystallization, though we are acquainted with several persons who have studied the subject. A valuable paper on the crystals of tinstone, by Mr Philips, has been presented to the Geological Society, and inserted in their transactions. The want of any English treatise on the subject, will oblige us to be more particular than would otherwise be proper for an article published in an Encyclopædia.

I. *Preliminary Notions.*

1. The object of the theory is to determine all the different forms which can be produced from the superposition of plates diminishing in size according to given laws, and in given directions, upon the different faces of a solid, the form of which is likewise given. Preliminary notions.

2. This solid, called the *nucleus* or *primitive form,* is always one of the six following: 1. The parallelopiped 2. The regular six-sided prism. 3. The rhomboidal dodecahedron. 4. The octahedron. 5. The regular tetrahedron. 6. The triangular dodecahedron, consisting of two six-sided pyramids, applied base to base.

3. By subdividing these primitive forms in the way described in the last Chapter, we obtain the shape of the integrant molecules. These are either, 1. Parallelopipeds. 2. Triangular prisms; or, 3. Tetrahedrons.

4. When the integrant molecules are tetrahedrons or triangular prisms, they are always so grouped together in the crystal, as to compose parallelopipeds. And the decrements which produce the secondary faces are always made by the abstraction of ranges of these parallelopipeds. Hauy gives to these parallelopipeds the name of *subtractive molecules.* As far as the theory of crystallization is concerned, we have to do only with molecules of the form of parallelopipeds, Indeed, the whole doctrine of the shape of the integrant molecules is entirely hypothetical.

5. When the nucleus is not a parallelopiped, we may always substitute in place of it a solid of that form, either by abstracting some of the faces if there are more than six, or by multiplying the subdivisions in the direction of the natural joints if it is a tetrahedron. But simpler results are often obtained by giving the preference to the true nucleus.

6. The decrements which the plates of superposition undergo, may take place in every possible direction. The limits of these directions are the edges and the diagonals of the faces of the nucleus. Between these two limits there are an infinity of intermediate directions, according as the molecules, the ranges of which determine the decrement, are conceived to be single, double, triple, &c. When the decrements are parallel to the edges, they are called *decrements on the edges;* when parallel to the diagonals, they are called *decrements on the angles;* and when they are parallel to lines intermediate between the edge and diagonal, they are called *intermediate decrements.*

Let us now run over all the primitive forms, giving, with respect to each, the method of calculating the results of all the laws of decrement of which they are susceptible; and beginning with the parallelopiped, which is the term of comparison to which the other forms are referred.

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PLATE CCXXIII. Fig. 35.

Theory of the parallelopiped.

II. *Theory of the Parallelopiped.*

Let AG (Fig. 35.) be a parallelopiped, the faces of which have any dimensions, and the angles any size at pleasure. Let us conceive this solid to be subdivided by planes parallel to its different faces into a multitude of elementary parallelopipeds, which constitute its integrant molecules. Each of its faces will be divided, of course, into a multitude of small parallelograms, which constitute the bases of as many molecules. If we choose any two of the six faces of this solid, provided that they be opposite, we may consider the solid as an assemblage of plates divided from each other by planes parallel to these faces.

Suppose, now, that new plates formed of small parallelopipeds, similar and equal to the preceding, are applied to the different faces of the parallelopiped, so that the faces in contact exactly coincide, just as is the case in the interior of the solid. There are three separate cases, which may be distinguished. First, The plates may extend by their edges in such a manner as exactly to inclose the nucleus, which will thus increase in size without altering its shape. Secondly, The plates may continue of the same size as the face of the nucleus to which they are applied; in which case, it is easy to see, that re-entering angles would be formed at the edges DC, BC, CG, &c. Thirdly, The plates may progressively decrease in certain directions, so that each will be passed by the preceding plate by a quantity equal to one or more ranges, either in breadth or height.

Of these three cases, the first relates to the primitive forms given immediately by crystallization, and is attended with no difficulty. The second is excluded by the laws of crystallization, no example of it ever occurring. The third constitutes the object of the theory.

Let us suppose, first, that the decrements take place in breadth on all the edges, by the subtraction of an equal number of ranges; and let us confine ourselves to consider the effect of the decrement which takes place parallel to the edge BC, upon the face ABCD.

If we suppose that the form of the integrant molecule (which is similar to the nucleus) is determined, and that the law of decrement is known, it will be easy to find the angle which ABCD makes with the face produced in consequence of the decrement. Let

Fig. 36. ag (Fig. 36.) be one of the molecules, whose faces, analogous to those of the parallelogram Fig. 37, are marked by the same letters. From the point c, draw cs and cr perpendicular to bc. But the ratio between these two lines is given by hypothesis, as is also the angle rcs, which measures the inclination of the faces $abcd$ and $bcgh$.

Now, let op (Fig. 35.) be the distance between the edge BC and the first plate of superposition, which distance is conceived to be measured upon the plane ABCD. It is evident, that op is equal to cr (Fig. 36.) multiplied by the number n of ranges subtracted, or $op = n \times cr$. From the point p (Fig. 36.) raise pu upon the lateral face of the first plate of superposition, and equal to that plate in height. We shall have $pu = cs$ (Fig. 36.), and $opu = scr$. Complete the triangle upo (Fig. 35.) It is evident, that the line ou will coincide with the secondary face of the crystal produced upon the edge BC, and that the angle pou will measure the incidence of that face upon the parallelogram ABCD. Now, as in the triangle upo, we know the two sides op, pu, and the included angle opu, it will be easy to find the angle pou, and therefore to obtain the incidence sought for. The triangle pou is called the *measuring triangle* by Hauy, and the same name is applied to all triangles performing the same function.

Let us now consider the effect of the decrement parallel to the same edge BC, but upon the parallelogram BCGH. Let oih be the *measuring triangle*, in which oi is the distance between the edge BC and the first plate of superposition, ih coincides with the lateral face of the same plate, and is equal to it in height, and oh coincides with the new face produced by the decrement.

Let n' be the number of ranges subtracted. We will have oi (Fig. 35.) $= n' \times cs$ (Fig. 36.); and ih (Fig. 35.) $= cr$ (Fig. 36.); and $oih = rcs$. Hence it will be easy to determine the angle which the face produced by decrement makes with BCGH (Fig. 35.) PLATE CCXXIII. Figs. 35, 36.

It may happen, that the two decrements which act upon the sides of BC, have such a relation to each other, that the two faces resulting from them coincide in the same plane, so that the side oh of the triangle oih is a continuation of the side ou of the triangle opu, as is represented in Fig. 37. To prove this, let us observe, that in this case the two triangles upo, oih are similar, both on account of the equality of the angles opu, hio, as of the parallelism of the sides op, ih, and the coincidence of the sides ou, ho, in the same direction. Hence Fig. 37.

$pu : op :: oi : ih$; or, which is the same thing,
cs (Fig. 36.) : $n \times cr :: n' \times cs : cr$. This gives us Fig. 36.

$$n' = \frac{1}{n}.$$

That is to say, that the two faces will be in the same plane whenever the decrements in the direction BC to GH are inversely, as those in the direction BC to AD; or, which comes to the same thing, when there is on one side a decrement in height equal to what takes place in breadth on the other. It is obvious also, that the two faces will be in the same plane when the decrement proceeds on both sides by one range.

Hence in all such cases, we may abstract one of the decrements altogether, and consider the face as a continuation of that which proceeds from the other decrement.

From what has been said, the method of proceeding to determine the incidences of the secondary faces upon all the other faces of the nucleus is obvious.

The greatest number of faces which a secondary solid can have from such decrements is 24, since the nucleus has twelve edges, each of which is capable of giving origin to two faces. These new faces will be all triangles, or partly triangles and partly trapeziums, according as the nucleus is or is not more or less elongated in one direction than in the other; or according as the decrements parallel to certain edges follow a more rapid law than the other decrements. The smallest number of faces which the secondary crystal can have is 12. In that case, all the decrements proceeding from the same edge are the inverse of each other. The simplest case is that in which the nucleus is a cube, and we have $n=1$, $n'=1$. In that hypothesis, the secondary crystal is a rhomboidal dodecahedron, as was shewn in the last Chapter.

Let us now determine, in the same manner, the decrements on the angles. The secondary faces formed by such decrements are called by Hauy *lateral faces*. Let us suppose, that decrements take place in

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Plate CCXXIII. Fig. 35.

breadth by the same number of ranges on all the angles of the parallelopiped (Fig. 35.); and let us take, as an example, that which takes place upon the angle BCD. Let C kl be the measuring triangle, in which C k measures the distance between the point C and the first plate of superposition; kl is applied to the lateral face of that plate, and measures its height, and C l coincides with the secondary face, produced by the decrement under consideration.

Fig. 36.

Having drawn the diagonals db, fh (Fig. 36.) on the bases of the molecule, let fall ct perpendicular to db, and xz perpendicular both to db and to fh. Let N be the number of ranges abstracted. We will have C k (Fig. 35.) $=$ N $\times$ ct (Fig. 36.), and kl (Fig. 35.) $= xz$ (Fig. 36.); and the angle C kl (Fig. 35.) will be equal to that which the plane $bdfh$ (Fig. 36.) forms with the plane fgh. But as these three quantities are known, hence it will be easy to find kCl (Fig. 35.) which measures the inclination of the new face to the parallelogram ABCD. The effect of the decrements on the other angles is calculated in the same manner.

Fig. 38.

Let us now consider the hypothesis in which the decrements that take place upon the two angles DCG, BCG have such a ratio to that which takes place upon the angle BCD, that the faces produced by the three decrements coincide in one plane. Let AG (Fig. 38.) be the nucleus as before. Let us suppose the decrement which takes place in breadth upon the angle BCD has such a measure, that the edge of the first plate of superposition passes by mr. In which case, each of the lines Cm, Cr will include as many lengths of molecules equal to cd or cb, (Fig. 36.) as there are ranges abstracted by the decrement. Having taken upon CG (Fig. 38.) a part Cc equal to cg, (Fig. 36.) let a plane pass through the points m, c, r. This plane is parallel to the face that will be produced by decrement. To prove this, draw the indefinite lines ms and ru parallel to CG, and prolong them above the nucleus, so as to make Mm or Rr equal to Cc. It is evident that Mm and Rr represent two faces situated on the side of the first plate; therefore the face produced by the decrement passes through the points M, R. It likewise passes through C, which is the point from which the decrement set out; therefore the plane MCR coincides with the face produced by the decrement. But the lines Cc, Mm, Rr, being three longitudinal edges of the molecules, situated parallel to each other between the two planes mcr, MCR, these two planes must be parallel. That is to say, mcr is parallel to the face produced by the decrement.

The same reasoning applies to the hypothesis when the decrements take place in height. In that case, it would be necessary, in order that the plane mcr were parallel to the face produced, to have $cm = cd$, (Fig. 36.) $cr = cb$, and that the line Cc (Fig. 38.) should contain as many times cg (Fig. 36.) as there are ranges subtracted in height.

Suppose the plane MCR to be prolonged above the faces CDFG, BCGH, and let us consider these prolongations as two faces that would have the effect of two decrements, the one upon the angle DCG, the other upon BCG. These decrements being equal, we may confine ourselves to that which takes place upon the angle DCG. Since the plane cmr is parallel to the face which results from the decrement, it is clear, that cm coincides with the inferior border of the first plate of superposition applied upon CDFG; and that Cr contains as many lengths of molecules as there are molecules subtracted in height.

If the decrement relative to the angle BCD takes place by one range, it is evident, that the two other decrements on the angles DCG and BCG will likewise take place by one range, because, in that case, the three lines Cm, Cr, Cc, being each equal to the length of one molecule, must of course have the same measure.

But if the decrement relative to the angle BCD take place by more than one range, then the two others will be necessarily intermediate, and it will be sufficient to have the law of the first decrement to determine the two others. Suppose, for example, that the decrement on the angle BCD takes place by three ranges in breadth. In that case, Cm and Cr will be equal each to the length of three molecules, and Cc will be equal to one length. Then the decrement on the angle DCG takes place in such a manner, that there are three lengths of a molecule subtracted along CD, and only one along CG; and this decrement takes place by three ranges in height, since Cr corresponds with three lengths of a molecule. The same rule holds with the decrement on the angle BCG.

In all cases of this nature, the theory considers only the decrements which take place according to the ordinary laws; because a much more simple solution results from it. The two other decrements are considered as subsidiary, and as coming to second the effect of the first, and to continue it over the parts adjacent to the face which it has produced.

The greatest number of faces which a secondary crystal can have on the hypothesis of a decrement, on all its angles, is 24; because there are eight solid angles, composed each of three plane angles, which are the terms from which as many decrements set out. The smallest number of faces, according to the same hypothesis, is eight. And though, in fact, there are always 24 decrements, yet eight only are considered; which enables us to apply the ordinary laws to determine the figure of the secondary crystal. The most simple case is that in which the nucleus is a cube, and all the decrements take place by one range. The result is the regular octahedron, as we saw in the last Chapter.

But it may happen that the three decrements which take place round the same solid angle, are intermediate. In that case, it is sufficient to determine one of them, in order to be able to judge of the two others, by means of a construction similar to that which we have already employed.

Plate CCXXIV. Fig. 3.

Let Fig. 3. represent the nucleus, marked with letters, according to the rules laid down in the last Chapter for writing the symbols of crystals. Let us conceive that a decrement takes place on the angle O, ascending, which produces a face parallel to the plane nrs, and of which the expression is $(\overset{2}{O}\ D^3\ F^4)$. From this it follows, that O$n = 3\,cd$, (Fig. 36.) O$r = 4\,cb$, and O$s = 2\,cg$.

Plate CCXXIII. Fig. 36.

The expression of the decrement on the left of the angle O will be $({}^4O\ D^3\ H^2)$ and that of the decrement on the right of the same angle $(O^3\ F^4\ H^2)$.

To determine the angles which the faces produced by intermediate decrements make with the corresponding faces of the nucleus, the most simple method is to consider each little group of molecules which results from the decrement, as forming a single molecule, which brings the calculus to that which is employed for the ordinary decrements on the angles. Let us take, as an example, the decrement upon the angle O, ascending, represented by the symbol $(\overset{2}{O}\ D^3\ F^4)$. It is easy to judge, that in this case, the group which represents the

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PLATE CCXXIV. Fig. 4.

molecule subtracted, is that which is represented in Fig. 4, in which the side mn is composed of three lengths of molecules, the side np of four lengths, and the side nk of two lengths, in consequence of a decrement by two ranges in height.

Fig. 5.

Having drawn upon the bases the diagonals mp, io, let fall nt perpendicular to mp, and us perpendicular both to mp and io. Let nty (Fig. 5.) be the measuring triangle, in which nt being conceived to coincide with the plane, AEOI (Fig. 3.) will be equal to nt. (Fig. 4.) We will likewise have ty (Fig. 5.) $=us$, (Fig. 4.) and the angle nty (Fig. 5.) will be equal to that which the plane $mpoi$ (Fig. 4.) makes with the triangle iko. Hence it will be easy to find the angle ynt (Fig. 5.) which measures the inclination wanted.

The solution of problems of this kind is often simplified in practice, in consequence of the regular form of the molecules. Let us suppose, for example, that they are cubes; and let us give to each of their edges the value of unity. We have, in such a case, (Fig. 4.) $mn=3$, $np=4$, $nk=2$, $mp=\sqrt{(mn)^2+(np)^2}=\sqrt{25}=5$; $nt=\frac{mn\times np}{mp}=\frac{12}{5}$; and $us=nk=2$. Hence, nt (Fig. 5.) $=\frac{12}{5}$ and $ty=2$. And

$$nt : ty :: \tfrac{12}{5} : 2 :: 6 : 5.$$

In this case the angle nty is right. Hence we see how easy it is in such a case to find the angle ynt.

Fig. 6.

The measuring triangles, relative to the decrements on the angles, may be substituted for those which we have considered in the decrements on the edges, and will serve equally to determine the secondary forms. Suppose, for example, that AG (Fig. 6.) represents a cubic nucleus, which undergoes decrements by two ranges upon the four edges of the base ABCD, and that we wish to know the angle of the pyramid sADCB produced by this decrement. Having drawn the diagonals BD, AC, let fall from their point of intersection o the line op perpendicular to CD. Draw sp. Upon op take the part pr, equal to two lengths of a molecule, and from r draw ru perpendicular upon the plane ABCD, and which, by hypothesis, is equal to the length of one molecule. The triangle upr will perform the function of the ordinary measuring triangle; and by means of the right angle urp and the ratio 2 : 1 between the sides pr and ur, it will be easy to find the incidence of DsC on the base ABCD, as well as the values of the other angles. For on account of the similar triangles upr, spo, the whole is reduced to calculate the angles of a right pyramid, in which the side BC of the base, which is double of po, is to the axis os as 4 to 1.

On the other hand, if we take upon Co the part Cn equal to two diagonals of the molecule, and from the point n raise nz perpendicular upon ABCD, Cn will represent the distance of the point C from the first plate of superposition, taken in the direction Co, and nz will be equal to the length of a molecule; hence it follows, that the triangle zCn may also perform the office of a measuring triangle. We will have C$n : nz :: 2\sqrt{2} : 1$; and because the triangle zCn is similar to the triangle sCo, the question considered in this new point of view is reduced to find the angles of a right pyramid, in which the demidiagonal Co of the base is to the axis os as $2\sqrt{2} : 1$. It is usual in this manner to substitute one measuring triangle for another, when there results, in consequence, a greater facility of calculation.

The preceding details may be considered merely as introductory observations, in order the better to explain the nature and importance of the *measuring* triangles. Let us now proceed to the method of calculating, and let us begin with the *rhomboid*, which (including the cube,) affords the easiest application of the theory, and at the same time the most varied results.

Algebraic expressions for the rhomboid.

PLATE CCXXIV. Fig. 7.

The first object to be attained, is the algebraic expressions for the principal lines in the rhomboid. Let Fig. 7. represent an obtuse rhomboid, because it occurs most usually; though the algebraic expressions will apply equally to any rhomboid whatever. Draw the diagonals bf, ad. The horizontal demidiagonal bc or cf is called g, while the oblique demidiagonal ac or ad is called p.

Fig. 8.

Let $adsg$ (Fig. 8.) be a four-sided figure formed by two opposite oblique diagonals ad, gs of the rhomboid, (Fig. 7.) and by the edges ag, ds included between these two diagonals. Such a figure is called the *principal section of the rhomboid.*

From the point d draw dr perpendicular to the axis as, and from the point g, draw gn, likewise perpendicular to the axis, and continue it till it meets ad. This line will bisect ad. For if the diagonals fg and bg (Fig. 7.) be drawn, the whole line gc (which is the same as in Fig. 8.) will be situated in the plane bfg (Fig. 7.) which passes through the point c. It is evident, likewise, that cn, which is a perpendicular drawn from the centre of the equilateral triangle bfg, is half the length of gn, which goes from the centre to one of the angles of this triangle. Now, gn is called the *perpendicular to the axis,* and cn the *semiperpendicular to the axis.*

The following are the algebraical expressions for the different edges of the rhomboid, in functions of g and p.

1. ab (Fig. 7.) $=\sqrt{(bc)^2+(ac)^2}=\sqrt{g^2+p^2}$.

2. $bf=2g$; $cg=\sqrt{\frac{4}{3}g^2}$; $cn=\sqrt{\frac{1}{3}g^2}$.

3. The perpendiculars gn and dr (Fig. 8.) divide the axis into three equal parts. For the similar triangles acn, adr, give $ad : ac :: ar : an$. But $ad=2ac$, therefore $ar=2an$. And the triangles dsr, gan being similar and equal, we have $rs=an$. Therefore, $an=nr=rs$. But $an=\sqrt{(ac)^2-(cn)^2}=\sqrt{p^2-\frac{1}{3}g^2}$. Hence, $as=3\sqrt{p^2-\frac{1}{3}g^2}=\sqrt{9p^2-\frac{9}{3}g^2}=\sqrt{9p^2-3g^2}$.

PROBLEM. Given the demidiagonals g and p to determine, in a general manner, three species of angles, namely, the plane angles of the rhomboid, the inclination of the respective faces, and the angles of the principal section.

1. For the plane angles, draw am (Fig. 7.) perpendicular to df, am will be the sine of the angle afd, supposing af as radius. Let us find the ratio between af and the cosine fm.

We have already $af=\sqrt{g^2+p^2}$.

Now, $am=\dfrac{bf\times ac}{df}=\sqrt{\dfrac{4g^2p^2}{g^2+p^2}}$.

Hence, fm or $\sqrt{(af)^2-(am)^2}=\sqrt{g^2+p^2-\dfrac{4g^2p^2}{g^2+p^2}}$

$$=\sqrt{\frac{g^4-2g^2p^2+p^4}{g^2+p^2}}.$$

Hence it follows, that $af : fm :: g^2+p^2 : \pm g^2 \mp p^2$. The upper signs of the last term belonging to the case when the rhomboid is obtuse, the lower to that in which it is acute.

This result gives us a remarkable property of the

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rhomboid. The cosine of its smaller plane angle is always a rational quantity, provided the expressions for the squares of the diagonals be rational.

2. For the inclination of the respective faces, as, for example, that of $a\,b\,d\,f$ or $d\,f\,g\,s$. From the point m, draw $m\,i$ perpendicular to $d\,f$, and prolonged till it meet $f\,s$. The angle $a\,m\,i$ measures the inclination wanted: $a\,i$ is the sine of that angle, taking $a\,m$ for radius. We have only to discover the ratio between $a\,m$ and $i\,m$, the cosine.

We have already $a\,m = \sqrt{\dfrac{4\,g^2\,p^2}{g^2+p^2}}$.

PLATE CCXXIV. Fig. 7, 8.

Draw $a\,k$ (Fig. 8.) perpendicular to $g\,s$; it will be equal to $a\,i$ (Fig. 7.) Now, $a\,k = \dfrac{g\,n \times a\,s}{g\,s} = \sqrt{\dfrac{\frac{4}{3}g^2\,(9\,p^2-3\,g^2)}{4\,p^2}} = \sqrt{\dfrac{3\,g^2\,p^2-g^4}{p^2}} = a\,i$.

Therefore, $a\,m : a\,i :: \sqrt{\dfrac{4\,p^2}{g^2+p^2}} : \sqrt{\dfrac{3\,p^2-g^2}{p^2}}$. And $a\,m : i\,m :: \sqrt{\dfrac{4\,p^2}{g^2+p^2}} : \sqrt{\dfrac{4\,p^2}{g^2+p^2} - \left(\dfrac{3\,p^2-g^2}{p^2}\right)} :: 2\,p^2 : g^2 - p^2$.

If the rhomboid is acute, the proportion will be $a\,m : i\,m :: 2\,p^2 : p^2 - g^2$.

Thus the expression for the cosine of the angle of incidence is rational, as well as of the plane angle of the rhomboid.

3. For the angles of the principal section, $a\,k$ (Fig. 7.) will be the sine of the angle g, taking $a\,g$ for radius; and from the preceding investigation, it is evident that (comparing together the sine and cosine) we have $a\,k : k\,g :: \sqrt{3\,g^2\,p^2 - g^4} : g^2 - p^2$. If the rhomboid were acute, the proportion would be $\sqrt{3\,g^2\,p^2-g^4} : p^2 - g^2$.

In the rhomboid which constitutes the primitive form of calcareous spar, we have $g = \sqrt{3}$ and $p = \sqrt{2}$ *. If we substitute these values in place of g and p in the preceding proportions, we obtain,

1. $a\,f : f\,m :: 5 : 1$; which gives $f\,a\,m = 11°\ 32'\ 13''$, therefore $b\,a\,f$ is $101°\ 32'\ 13''$.

2. $a\,m : i\,m :: 4 : 1$; which gives for the angle $a\,m\,i$ $75°\ 31'\ 20''$.

3. $a\,k : k\,g$ (Fig. 8.) $:: 3 : 1$; which gives for the angle $a\,g\,s$ $71°\ 33'\ 54''$.

Let us now determine the results of the different laws of decrement of which the rhomboid is susceptible. There are five different kinds of decrement possible, which give secondary forms, namely,

1. A decrement on the superior edges $a\,b$, $a\,f$.
2. A decrement on the superior angle a.
3. A decrement on the inferior edges $d\,b$, $d\,f$.
4. A decrement on the lateral angles b, f.
5. A decrement on the inferior angle d.

We shall consider here only the secondary forms resulting from a decrement by one range of molecules.

1. *Decrements on the Superior Edges.*

Decrements on the superior edges.

These decrements in general produce dodecahedrons, with triangular faces, three edges of which, taken alternately, will coincide with the edges $a\,b$, $a\,f$, $a\,g$, &c. of the nucleus (Fig. 7.) and the others will be raised above the oblique diagonals $a\,d$, $a\,q$, &c. The axis of the secondary crystal will be the same as the axis of the nucleus.

Fig. 9.

Let $a\,d\,s\,g$ (Fig. 9.) be the principal section of the nucleus, $a\,m$ the edge of the secondary crystal which rises above the diagonal $a\,d$, and which must be in the plane that passes through a, d, s; let $s\,m$ be the lower corresponding edge, which coincides with the edge $s\,d$ of the primitive rhomboid.

PLATE CCXXIV. Fig. 9.

Let $a\,z\,t$ be the measuring triangle, which we will consider here as if the decrements took place upon the angle a, observing, that to one range of molecules subtracted towards the edges $a\,b$, $a\,f$ (Fig. 7.) corresponds the oblique diagonal of a molecule, which measures the quantity that one plate of superposition passes another.

The first point is to determine the ratio between the sides $a\,z$ and $t\,z$ of this triangle. Let a be the length of a molecule, and p' its oblique semidiameter. Calling n the number of diameters subtracted, we have $a\,z : t\,z :: 2\,p' \times n : a$; and, because the dimensions of a molecule are proportional to those of the nucleus, $a\,z : t\,z :: 2\,n\,p : \sqrt{g^2+p^2}$.

Let us determine likewise the ratio between $m\,u$ perpendicular to the axis relative to the secondary dodecahedron, and the part $a\,u$ of the axis comprehended between the summit and that perpendicular.

1. For $m\,u$. The similar triangles $m\,s\,u$, $d\,s\,r$, give $d\,s : d\,r :: s\,m : m\,u$. But $d\,s = \sqrt{g^2+p^2}$ and $d\,r = \sqrt{\frac{4}{3}\,g^2}$. We only want to know $s\,m$, or rather its part $d\,m$, since the rest of it is known. The similar triangles $a\,z\,t$, $a\,d\,m$, give $a\,z : t\,z :: a\,d : d\,m$, or $2\,n\,p : \sqrt{g^2+p^2} :: 2\,p : d\,m = \frac{1}{n}\sqrt{g^2+p^2}$. Therefore $s\,m = \sqrt{g^2+p^2} + \frac{1}{n}\sqrt{g^2+p^2} = \frac{n+1}{n}\sqrt{g^2+p^2}$. Hence the proportion $d\,s : d\,r :: s\,m : m\,u$, becomes $\sqrt{g^2+p^2} : \sqrt{\frac{4}{3}\,g^2} :: \frac{n+1}{n}\sqrt{g^2+p^2} : m\,u = \frac{n+1}{n}\sqrt{\frac{4}{3}\,g^2}$.

2. For $a\,u$. Let us find $s\,u$, and subtract it from $a\,s$.

We have $d\,s : r\,s :: s\,m : s\,u$, or $\sqrt{g^2+p^2} : \frac{1}{3}\sqrt{9\,p^2-3\,g^2} :: \frac{n+1}{n}\sqrt{g^2+p^2} : s\,u = \frac{n+1}{3\,n}\sqrt{9\,p^2-3\,g^2}$. Therefore $a\,u = \sqrt{9\,p^2-3\,g^2} - \left(\frac{n+1}{3\,n}\right)\sqrt{9\,p^2-3\,g^2} = \frac{2\,n-1}{3\,n}\sqrt{9\,p^2-3\,g^2}$. Hence $m\,u : a\,u :: \frac{n+1}{n}\sqrt{\frac{4}{3}\,g^2} : \frac{2\,n-1}{3\,n}\sqrt{9\,p^2-3\,g^2}$.

Fig. 10.

Let $b'\,a\,m$, $f'\,a\,m$, (Fig. 10.), be two neighbouring faces situated towards the superior summit of the secondary dodecahedron, and so chosen that the edges $a\,b'$, $a\,f'$, coincide with those marked with the same letters in Fig. 7; in which case, the edge $a\,m$ (Fig. 10.) will be that which rises above the diagonal $a\,d$ (Fig. 7.)

The semidiameters of the nucleus g and p, and the number n of decrements being given, let us determine the incidence of $b'\,a\,m$ (Fig. 10.) on $f'\,a\,m$, and that of $b'\,a\,m$ on the face adjacent to it, on the other side of $a\,b'$.

Let us suppose a plane $b'\,y\,f'$ perpendicular to the axis $a\,o$. Draw $b'\,o$, $f'\,o$, $y\,o$, upon this plane, and $f'\,r$, $f'\,p$, perpendicular the one to $y\,o$, the other to $a\,y$,

* These ratios are probably not quite correct. Hence some little error in the angles found.

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and join the points p, r. The angle $f' p r$ will be equal to one half of the angle, which gives the incidence of $b' a y$ upon $f' a y$. Draw $y e$, $y h$, perpendicular the one to $b' o$, the other to $a b'$, then join the points e, h. The angle $y h e$ will be the half of that which measures the incidence $b' o y$ on the adjacent face $a b$. We will therefore obtain the two incidences wanted, if we find the ratio between the sine $f' r$ and the cosine $p r$ of the angle $f' p r$, and the ratio between the sine $y e$ and the cosine $e h$ of the angle $y h e$.

PLATE CCXXIV. Fig. 9, 10.

Having produced $g n$ (Fig. 9.) till it meets $a m$, we may suppose, for the greater simplicity, that the plane $b' y f' o$ (Fig. 10.) is of the same height as $g x$ (Fig. 9.), so that $a o$ (Fig. 10.) $= a n$ (Fig. 9.) In that case, we shall have likewise $f' o$ or $b' o$ (Fig. 10.) $= g n$ (Fig. 9.), and $y o$ (Fig. 10.) $= n x$ (Fig. 9.)

Let us obtain separately $f' r$ and $p r$.

1. For $f' r$. It is evident that $f' r$ is the half of the line which joins the points b, f'; and since these points re conceived to be of the same height as $g x$, they concide with the points b, f (Fig. 7.) Hence it follows at $f' r$ (Fig. 10.) $= b c$ (Fig. 7.) $= g$.

2. For $p r$. The triangles $a o y$, $r p y$ (Fig. 10.) are similar, from their position, and the equality of the angles $a o y$, $r p y$, both right angles. Hence $a y : a o :: y r : p r$. Let us obtain values of $a y$, $a o$, and $y r$.

$$a y = \sqrt{(y o)^2 + (a o)^2}\,;\ y o = n x \text{ (Fig. 9.)}$$

$$a u : m u :: a n : n x, \text{ or}$$

$$\frac{2n-1}{3n}\sqrt{9p^2 - 3g^2} : \frac{n+1}{n}\sqrt{\tfrac{4}{3}g^2} :: \tfrac{1}{3}\sqrt{9p^2 - 3g^2}$$

$$: n x = \frac{n+1}{2n-1}\sqrt{\tfrac{4}{3}g^2} = y o \text{ (Fig. 10.)}$$

$a o = \frac{1}{3}\sqrt{9p^2 - 3g^2}$. Let us, for greater simplicity, denote the value of the axis $\sqrt{9p^2 - 3g^2}$ by a, we will have $a y = \sqrt{\left(\frac{n+1}{2n-1}\right)^2 \frac{4}{3} g + \frac{1}{9} a^2}$.

We still want $y r$. The angle $f' o r$ being an angle of $60°$, and the angle $f r s$ of $90°$, or $= \frac{1}{2} f' o = \frac{1}{2}\sqrt{\frac{4}{3}g^2}$

$$y r = y o - o r = \frac{n+1}{2n-1}\sqrt{\tfrac{4}{3}g^2} - \tfrac{1}{2}\sqrt{\tfrac{4}{3}g^2} =$$

$$\frac{3}{2n-1}\sqrt{\tfrac{1}{3}g^2}.$$

Therefore the proportion $a y : a o :: y r : p r$ becomes

$$\sqrt{\left(\frac{n+1}{2n-1}\right)^2 \tfrac{4}{3}g^2 + \tfrac{1}{9}a^2} : \sqrt{\tfrac{1}{9}a^2} :: \frac{3}{2n-1}\sqrt{\tfrac{1}{3}g^2} :$$

$$p r = \frac{\frac{1}{2n-1}\sqrt{\frac{1}{3}a^2 g^2}}{\sqrt{\left(\frac{n+1}{2n-1}\right)^2 \frac{4}{3}g^2 + \frac{1}{9}a^2}}.$$

$$\text{Hence } f' r : p r :: g : \frac{\frac{1}{2n-1}\sqrt{\frac{1}{3}a^2 g^2}}{\sqrt{\left(\frac{n+1}{2n-1}\right)^2 \frac{4}{3}g^2 + \frac{1}{9}a^2}} ::$$

$$\sqrt{\left(\frac{n+1}{2n-1}\right)^2 \tfrac{4}{3}g^2 + \tfrac{1}{9}a^2} : \frac{1}{2n-1}\sqrt{\tfrac{1}{3}a^2} ::$$

$$\sqrt{(n+1)^2\, 4 g^2 + (2n-1)^2 \tfrac{1}{3} a^2} : a.$$

Let us now find the ratio between the sine $y e$ and the cosine $e h$ of the angle $y h e$.

1. For $y e$. We have $y e = \sqrt{(y o)^2 - (o e)^2}$; $y o^2 = \left(\frac{n+1}{2n-1}\right)^2 \frac{4}{3} g^2$, as before determined. Further, on account of $e o y = 60°$, and $y e o = 90°$, we have $o e = \frac{1}{2} y o$. Hence $y e = \sqrt{\frac{1}{4}(y o)^2} = \sqrt{\left(\frac{n+1}{2n-1}\right)^2 g^2}$.

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2. For $e h$. The similar triangles $b' o a$, $b' h e$, give $a b' : a o :: b' e : e h$. Now,

$$a b' = \sqrt{(b' o)^2 + (a o)^2} = \sqrt{\tfrac{4}{3}g^2 + \tfrac{1}{9}a^2}$$

$$a o = \sqrt{\tfrac{1}{9}a^2}$$

$$b' e = b' o - o e = \sqrt{\tfrac{4}{3}g^2} - \left(\frac{n+1}{4n-2}\right)\sqrt{\tfrac{4}{3}g^2} =$$

$$\left(1 - \left(\frac{n+1}{4n-2}\right)\right)\sqrt{\tfrac{4}{3}g^2} = \frac{3n-3}{4n-2}\sqrt{\tfrac{4}{3}g^2}.$$

Therefore the proportion $a b' : a o :: b' e : e h$, becomes

$$\sqrt{\tfrac{4}{3}g^2 + \tfrac{1}{9}a^2} : \sqrt{\tfrac{1}{9}a^2} :: \frac{3n-3}{4n-2}\sqrt{\tfrac{4}{3}g^2} : e h.$$

Therefore

$$e h = \frac{\frac{3n-3}{4n-2}\sqrt{\frac{4}{27}a^2 g^2}}{\sqrt{\frac{4}{3}g^2 + \frac{1}{9}a^2}} = \frac{\frac{n-1}{2n-1}\sqrt{\frac{1}{3}a^2 g^2}}{\sqrt{\frac{4}{3}g^2 + \frac{1}{9}a^2}} =$$

$$\frac{n-1}{2n-1}\sqrt{\frac{3a^2 g^2}{12g^2 + a^2}}.$$

Therefore

$$y e : e h :: \sqrt{\left(\frac{n+1}{2n-1}\right)^2 g^2} : \frac{n-1}{2n-1}\sqrt{\frac{3a^2 g^2}{12g^2 + a^2}} :: n+1 :$$

$$(n-1)\sqrt{\frac{3a^2}{12g^2 + a^2}} :: (n+1)\sqrt{12g^2 + a^2} : (n-1)\sqrt{3a^2} ::$$

$$(n+1)\sqrt{12g^2 + 9p^2 - 3g^2} : (n-1)\sqrt{27p^2 - 9g^2} :: (n+1)$$

$$\sqrt{g^2 + p^2} : (n-1)\sqrt{3p^2 - g^2}.$$

There is a variety of calcareous spar, whose summits have each six faces resulting from a decrement by three ranges upon the superior edges of the nucleus, and which combine with other intermediate faces, of which we do not take any notice. To apply the above formulæ to this variety of crystal, we must make $n = 3$, $g = \sqrt{3}$, $p = \sqrt{2}$.

When these values are substituted, we get

1. $b' r : p r :: \sqrt{89} : \sqrt{3}$, which gives $79°\ 35'\ 47''$ for the angle $f' p r$, and $159°\ 11'\ 34''$ for the incidence of $b' a m$ on $f' a m$.

2. $y e : e h :: \sqrt{20} : \sqrt{3}$, which gives $68°\ 49'\ 43''$ for the angle $y h e$, and $137°\ 39'\ 26''$ for the incidence of $b' a m$ on the adjacent face $a b'$.

Let us examine whether there be a possible law of decrement for the dodecahedron with isosceles triangular faces, or composed of two right pyramids applied base to base. In that case, $y o = b' o$. Hence likewise $n x$ (Fig. 9.) $= g n$, or $\frac{n+1}{2n-1}\sqrt{\frac{4}{3}g^2} = \sqrt{\frac{4}{3}g^2}$. This gives $n = 2$. Hence the form is possible by means of a decrement by two ranges.

PLATE CCXXIV. Fig. 9.

In proportion as the edge $a m$ is elevated by its lower extremity, by making the angles larger with the axis $a o$ (Fig. 10.), the angle which $b' a m$ makes with the face adjacent to $a b'$ increases in size, and there is a term when these two faces are in the same plane. The secondary crystal becomes then a rhomboid, the oblique diagonals of which coincide with the edges $a b'$, $a f'$, &c.

Fig. 10.

To find the law which produces this rhomboid, let it be observed, in the first place, that when it takes place, the cosine eh disappears; so that, in that case, $\frac{n-1}{an-1}\sqrt{\frac{3a^2g^2}{12g^2+a^2}}=0$, or $n-1=0$. Hence $n=1$. This was already evident, from what was said before.

Plate CCXXIV. Fig. 9.

Let us determine the two demidiagonals of this rhomboid. Let g' and p' be these two lines; sm (Fig. 9.) being the oblique diagonal of the rhomboid, mu will be the perpendicular upon the axis. Then $mu=\sqrt{\frac{4}{3}g'^2}$. But on the other hand, $mu=\frac{n+1}{n}\sqrt{\frac{4}{3}g^4}=2\sqrt{\frac{4}{3}g^2}$. Hence $g'=2g$.

In this case, the line mu is elevated so as to be in the direction of gn. This is a a necessary consequence of sm being the oblique diagonal. Hence $su=2sr$, and $sm=2sd$. So that $2p'=2\sqrt{g^2+p^2}$ or $p'=\sqrt{g^2+p^2}$. That is to say, that the horizontal demidiagonal g' is double that of the nucleus, and that the oblique demidiagonal p' is equal to the edge of the nucleus.

This case exists in a variety of crystals, and particularly in that variety of calcareous spar which Hauy has called *equiaxe*. In it $g=\sqrt{3}$, $p=\sqrt{2}$. Hence $g'=\sqrt{12}$, and $p'=\sqrt{5}$. From these data, it is easy to determine the angles, employing the formulæ above explained.

Let us suppose that the secondary crystal is a cube, and let us enquire what, in that case, ought to be the ratio between the two demidiagonals of the nucleus. We may make $g'=1$, $p'=1$. Then substituting in the equations $g'=2g$, $p'=\sqrt{g^2+p^2}$, we obtain $1=2g$, or $g=\frac{1}{2}$. $1=\sqrt{g^2+p^2}$, or $1=g^2+p^2=\frac{1}{4}+p^2$. Hence $p=\sqrt{\frac{3}{4}}=\frac{1}{2}\sqrt{3}$. And $g:p::1:\sqrt{3}$. That is to say, that the nucleus is an acute rhomboid, with angles of 60° and 120°. This would be the case with the cube of fluor spar, if, in place of the octahedron, which is the real nucleus, we were to substitute the rhomboid which results from the application of two regular tetrahedrons upon the two opposite faces of the octahedron.

2. *Decrements on the Superior Angle.*

Decrements on the superior angle.

These decrements always give rhomboids for secondary forms. Let us continue to employ Fig 9. in which ao represents the oblique diagonal of one of the faces of the secondary crystal, and so the edge contiguous to that diagonal; so that, if from the point o we draw a perpendicular to the axis, it will coincide with dr, since the point o ought to be situated opposite the third part of the axis. The angle atz, which in the preceding case supplied the place of the measuring angle, becomes here the real measuring angle; and the quantity n will always signify the number of diagonals subtracted, with this difference, that we must double the number to have that of the ranges subtracted.

Let us express, in a general manner, the ratio between the two semidiameters g' and p' of the secondary rhomboid, supposing us to know g, p, and n.

We have, in the first place, $or:ar::\sqrt{\frac{4}{3}g'^2}:\frac{2}{3}\sqrt{gp'^2-3g'^2}$. And because the expressions for mu and au remain the same as in the case of decrements on the superior edges, we will have $or:ar::mu:au::\frac{n+1}{n}\sqrt{\frac{4}{3}g^2}:\frac{2n-1}{3n}\sqrt{9p'^2-3g^2}::\sqrt{\frac{4}{3}g'^2}:\frac{2}{3}\sqrt{9p'^2-3g'^2}$; or, removing the radical signs, and reducing, we have $g'^2:12p'^2-4g^2::(n+1)^2g^2:(2n-1)^2(3p^2-g^2)$.

Taking the product of the extremes and means, and transposing, we get $\left((2n-1)^2 3p^2+(n+1)^2 4g^2-(2n-1)^2g^2\right)g'^2=(n+1)^2 12g^2p'^2$, and developing $(n+1)^2 4g^2-(2n-1)^2g^2$, and reducing, $\left((2n-1)^2 3p^2+(12n+3)g^2\right)g'^2=(n+1)^2 12g^2p'^2$.

Then $g':p'::\sqrt{(n+1)^2 12g^2}:\sqrt{(2n-1)^2 3p^2+(12n+3)g^2}$.

If we suppose the decrement to take place by two ranges, and that the nucleus is a rhomboid, in which $g=\sqrt{9}$, $p=\sqrt{10}$, we will have $n=1$, and the proportion becomes $g':p'::\sqrt{144}:\sqrt{55}$. This result will be found in the variety of oligiste iron ore, or iron glance, called *binaire* by Hauy.

Let us enquire whether, among all the possible secondary rhomboids, there be one similar to that which results from a decrement by one range upon the superior edges.

We have seen that the oblique diagonals of this last rhomboid coincided with the superior edges, such as ag of the nucleus. On the other side am is one of the oblique diagonals of the first rhomboid, and since they are similar, we must have $gan=mau$, and consequence the rectangular triangles ang, aun are likewise similar. Therefore $mu:au::gn:an$. Or $\frac{n+1}{n}\sqrt{\frac{4}{3}g^2}:\frac{2n-1}{3n}\sqrt{a^2}::\sqrt{\frac{4}{3}g^2}:\frac{1}{3}a$. Or $\frac{n+1}{n}:\frac{2n-1}{3n}::1:\frac{1}{3}$. From which we get $n=2$. Hence the decrement will take place by 4 ranges.

If we make $n=\frac{1}{2}$, which is the case when the decrement takes place by one range, we have (taking the ratio between mu and au),

$\frac{n+1}{n}\sqrt{\frac{4}{3}g^2}:\frac{2n-1}{3n}\sqrt{a^2}::(3n+3)\sqrt{\frac{4}{3}g^2}:(2n-1)\sqrt{a^2}::\frac{9}{2}\sqrt{\frac{4}{3}g^2}:o\sqrt{a^2}$. Thus the ratio between mu and au in the present case becomes infinite, which indicates that the diagonal ao itself is infinite, and of course the face upon which it falls is horizontal. This case occurs in calcareous spar, in the tourmaline, in sulphate of iron, &c. In them, either a second decrement takes place, from which there result lateral faces, whose intersections limit the superior face, or there remain faces parallel to those of the nucleus.

If we suppose now decrements in height, it is easy to see that the faces resulting from them will throw themselves to the opposite side of that where the decrement takes place, so that we shall still have secondary rhomboids, always less and less obtuse as the height of the plates increases. Let us point out the method of calculating the effects of these decrements.

Plate CCXXIV. Fig. 11.

Let $agsd$ (Fig. 11.) be the principal section of the nucleus, and azt the measuring triangle, in which az measures a single range, that is to say, is equal to an oblique semidiameter of a molecule; and tz is equal to as many lengths of molecules as there are ranges subtracted in height.

If we prolong ta above ag, the line ay will coincide with the oblique diagonal of the secondary rhomboid, the principal section of which will be $apsk$.

Having continued sg till it meets ap, draw yu perpendicular to the axis as. We must, in the first place, determine the ratio between uy and au.

1. For uy. The similar triangles sgm, syu give $sg:sy::gm:uy$. But $sg=2p$; $sy=sg+gy$. But we do not know the value of gy. To find it, the similar triangles atz, ayg, give us $az:tz::gy:ag$, or

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$p : n\sqrt{g^2+p^2} :: gy : \sqrt{g^2+p^2}$. Hence $gy=\frac{p}{n}$. And of consequence, $sy=2p+\frac{p}{n}=\frac{2np+p}{n}$. Lastly, $gm=\sqrt{\frac{4}{3}g^2}$.

So that the proportion becomes

$$2p : \frac{2np+p}{n} :: \sqrt{\tfrac{4}{3}g^2} : uy=\frac{2n+1}{2n}\sqrt{\tfrac{4}{3}g^2}.$$

2. For au. $au=as-us=\sqrt{9p^2-3g^2}-us$. But we do not know the value of us. To find it, the triangles smg, suy, give us $sg : sy :: sm : us$, or $2p : \frac{2np+p}{n} :: \frac{2}{3}\sqrt{a^2} : us$. Hence $us=\frac{2n+1}{3n}\sqrt{a^2}$. Therefore we have $au=\sqrt{a^2}-\left(\frac{2n+1}{3n}\right)\sqrt{a^2}=\frac{n-1}{3n}\sqrt{a^2}$.

Therefore we have finally

$$uy : au :: \frac{2n+1}{2n}\sqrt{\tfrac{4}{3}g^2} : \frac{n-1}{3n}\sqrt{a^2} :: (6n+3)\sqrt{\tfrac{4}{3}g^2} : (2n-2)\sqrt{a^2}.$$

Let us now determine, in a general manner, the relation between the two demidiagonals g' and p' of the secondary rhomboid.

In the first place, it is evident that, in the secondary rhomboid, lm is the semiperpendicular upon the axis, and am the third of that axis; and because lm and am are proportional to uy and au, we have

$$(6n+3)\sqrt{\tfrac{4}{3}g^2} : (2n-2)\sqrt{9p^2-3g^2} :: \sqrt{\tfrac{4}{3}g'^2} : \tfrac{1}{3}\sqrt{9p'^2-3g'^2}.$$

And, reducing and suppressing the radical signs, $(2n+1)^2 4g^2 : (2n-2)^2(3p^2-g^2) :: g'^2 : 3p'^2-g'^2$.

Taking the product of the extremes and means, we get $\left((2n-2)^2 3p^2-(2n-2)^2g^2+(2n+1)^2 4g^2\right)g'^2=(2n+1)^2 12g^2p'^2$; and developing the quantities $(2n-2)^2$ and $(2n+1)^2$, then reducing and taking the ratio of g' to p', we obtain

$$g' : p' :: \sqrt{(2n+1)^2 3g^2} : \sqrt{(n-1)^2 3p^2+(3n^2+6n)g^2}.$$

Let $n=\frac{1}{2}$, $g=1$, $p=\sqrt{3}$, as in the acute rhomboid of 60° and 120°, we get $g' : p' :: \sqrt{8} : \sqrt{3}$, a result similar to that to which we would obtain by supposing a decrement by two ranges in breadth upon any two opposite angles of the cubic nucleus. This result, applied to the acute rhomboid, is realized in a variety of *grey copper ore*.

It is remarkable, that the same rhomboids which result from a decrement in breadth upon the superior angle, the faces of which are turned towards the oblique diagonals of the nucleus, are still susceptible of being produced in consequence of a decrement in height, such that their faces correspond with the edges of the nucleus. Let us obtain a formula by means of which, the law being given relative to one of these rhomboids, we may know likewise that upon which the other depends. Let n be, as usual, the number of ranges subtracted by the decrement in breadth, and let n' denote the decrement in height. In order that the two rhomboids should be similar, it is necessary that the ratio between the semiperpendicular on the axis and the third of that axis be equal to each other. Therefore, $\frac{n+1}{n}\sqrt{\tfrac{4}{3}g^2} : \frac{2n-1}{3n}\sqrt{9p^2-3g^2} :: 6n'+3\sqrt{\tfrac{4}{3}g^2} : 2n'-2\sqrt{9p^2-3g^2}$. Or, simplifying, $n+1 : 2n-1 :: 2n'+1 : 2n'-2$. Taking the product of the extremes and means, we have $2nn'+4n=4n'-1$. Hence $n=\frac{4n'-1}{2n'+4}$, and $n'=\frac{4n+1}{4-2n}$.

Let $n'=\frac{1}{2}$, as in the former case. We will then have $n=\frac{5}{7}$; a decrement which has not hitherto been observed in the mineral kingdom. Let $n=2$, then $n'=\frac{9}{0}$ or an infinite quantity. From hence we learn, that in such a case, the line ap coincides with the line ag, that is to say, that the secondary rhomboid is similar to that which results from a decrement by one range on the superior edges of the nucleus.

3. *Decrements on the Inferior Edges.*

Decrements on the inferior edges.

The secondary solids produced by this kind of decrement are always dodecahedrons, with scalene triangular faces, one of the sides of which coincides with one of the edges bd, df, fg, &c. (Fig. 7.) of the primitive rhomboid.

Plate CCXXIV. Fig. 7, 12.

Let $adsg$ (Fig. 12.) be the principal section of this rhomboid, pu the axis of the secondary dodecahedron, pd, du two contiguous edges of that dodecahedron. Let dho be the measuring triangle in which ho is equal to the length of a molecule, and dh to as many oblique diagonals of molecules as there are ranges subtracted. Let n be the number of these diagonals, p' the half of a single diagonal, and g' the half of the horizontal diagonal.

We will have $ho=\sqrt{g'^2+p'^2}$, and $dh=2np'$.

Let us, in the first place, determine the part ap of the axis of the secondary crystal, or the quantity that this axis exceeds in length the axis of the nucleus.

Having produced ga till it meets dp, we will have the similar triangles pal, psd which give us $ds : ps :: al : ap$. But,

1. $ds=\sqrt{g^2+p^2}$.
2. $ps=ap+as=ap+\sqrt{9p^2-3g^2}$.
3. For al. The similar triangles dho, dal, give us $dh : oh :: ad : al$; or

$$2np' : \sqrt{g'^2+p'^2} :: 2p : al=\frac{p}{n}\sqrt{\frac{g'^2+p'^2}{p'^2}}.$$

And because the dimensions of the molecules are proportional to those of the nucleus, we have, by substituting $\frac{g^2+p^2}{p^2}$ for $\frac{g'^2+p'^2}{p'^2}$, $al=\frac{1}{n}\sqrt{g^2+p^2}$.

Hence the proportion $ds : ps :: al : ap$ becomes

$$\sqrt{g^2+p^2} : ap+\sqrt{9p^2-3g^2} :: \frac{1}{n}\sqrt{g^2+p^2} : ap.$$ Therefore $ap=\frac{1}{n-1}\sqrt{9p^2-3g^2}$.

Having thus obtained ap, let us determine the respective coincidences of the faces of the dodecahedron at the edges contiguous to the summit. Let as (Fig. 13.) be the nucleus, and bpd, dpf, fpq three of the faces of the dodecahedron. Draw the horizontal semidiagonal de of the rhomb $dfqs$, then having produced pf, draw dk perpendicular to it, and join the points k, e. The angle dke wil measure half the inclination of dpf to fpq. Fig. 13.

Draw the horizontal semidiagonal fc of the rhomb $abdf$ and fz perpendicular to dp, and join the points c, z. The angle fzc will measure half the inclination of fpd to bpd, and it is easy to see that this incidence will be always greater than the first.

Let us, in the first place, find the value of de and ek. But it is evident that $de=g$. We have only therefore to find ek.

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Plate CCXXIV. Figs. 12, 13.

Let pg (Fig. 12.) be the edge which passes through the points marked by the same letters in Fig. 13. and which is equal to pf. Having drawn sy (Fig. 12.) perpendicular to pg produced and through the point t, the centre of sg, another perpendicular tg to the same line, we have $tg=ek$ (Fig. 13.) To obtain the value of tg, let us find that of its double sy.

The similar triangles png, pys give us $pg:gn::ps:sy$.

1. For pg. We have $pg=\sqrt{(pn)^2+(gn)^2}$, and $pn=ap+an=\frac{1}{n-1}\sqrt{9p^2-3g^2}+\frac{1}{3}\sqrt{9p^2-3g^2}=\frac{n-2}{3n-3}\sqrt{9p^2-3g^2}$. And $gn=\sqrt{\frac{4}{3}g^2}$. Hence $pg=\sqrt{\left(\frac{n+2}{3n-3}\right)^2a^2+\frac{4}{3}g^2}$.

2. $gn=\sqrt{\frac{4}{3}g^2}$, as has been just observed.

3. For ps. We have $ps=ap+as=\frac{1}{n-1}\sqrt{a^2}+\sqrt{a^2}=\frac{n}{n-1}\sqrt{a^2}$.

The proportion $pg:gn::ps:sy$, thus becomes $\sqrt{\left(\frac{n+2}{3n-3}\right)^2a^2+\frac{4}{3}g^2}:\sqrt{\frac{4}{3}g^2}::\frac{n}{n-1}\sqrt{a^2}:sy=\frac{n}{n-1}\sqrt{\frac{\frac{4}{3}a^2g^2}{\left(\frac{n+2}{3n-3}\right)^2a^2+\frac{4}{3}g^2}}$. Taking the half of this expression for the value of ek (Fig. 13.), we will have

$$de:ek::g:\frac{n}{n-1}\sqrt{\frac{\frac{1}{3}a^2g^2}{\left(\frac{n+2}{3n-3}\right)^2a^2+\frac{4}{3}g^2}}::$$
$$\sqrt{\left(\frac{n+2}{3n-3}\right)^2a^2+\frac{4}{3}g^2}:\sqrt{\left(\frac{n}{n-1}\right)^2\frac{1}{3}a^2}.$$

Let us now find the value of fc and cz. But as $fc=g$, we have only to find cz.

From the point a (Fig. 12.), taken at the extremity of the axis, and from the point c, in the centre of ad, draw the lines ax and cz both perpendicular to dp. cz is the same line as in Fig. 13, and ax is its double.

But the similar triangles prd, pxa give $dp:dr::ap:ax$.

As ap and dr are already known, we have only to find dp.

We have $dp=\sqrt{(pr)^2+(dr)^2}$. And $pr=ap+ar=\frac{1}{n-1}\sqrt{a^2}+\frac{2}{3}\sqrt{a^2}=\frac{2n+1}{3n-3}\sqrt{a^2}$. Hence $dp=\sqrt{\left(\frac{2n+1}{3n-3}\right)^2a^2+\frac{4}{3}g^2}$.

The proportion above stated of course becomes $\sqrt{\left(\frac{2n+1}{3n-3}\right)^2a^2+\frac{4}{3}g^2}:\sqrt{\frac{4}{3}g^2}::\frac{1}{n-1}\sqrt{a^2}:ax$. Taking the half of ax, found from this proportion, we get the value of cz (Fig. 13.). Now $fc:cz::g:$

$$\sqrt{\frac{\left(\frac{1}{n-1}\right)^2\frac{1}{3}a^2g^2}{\left(\frac{2n+1}{3n-3}\right)^2a^2+\frac{4}{3}g^2}}::\sqrt{\left(\frac{2n+1}{3n-3}\right)^3a^2+\frac{4}{3}g^2}:$$
$$\sqrt{\left(\frac{1}{1n-}\right)^2\frac{1}{3}a^2}.$$

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Let us now apply the different expressions thus found.

If in the equation $ap=\frac{1}{n-1}\sqrt{9p^2-3g^2}$ we make $n=2$, it becomes $ap=\sqrt{9p^2-3g^2}$, that is to say, that in this case the part of the axis of the dodecahedron which passes the axis of the nucleus on each side, is equal to the axis; or which comes to the same thing, that the axis of the dodecahedron is three times the length of the axis of the nucleus. This property is general.

It may be useful to observe in passing, that the two solids have the same ratio to each other as the axes. We leave the demonstration of this as an exercise to the young crystallographer.

If we make $n=1$, we have $ap=\frac{1}{0}\sqrt{9p^2-3g^2}$. This indicates, that in such a case the axis becomes infinite, and of course the planes produced by the decrements are vertical. This case occurs in the corundum.

Let us resume the hypothesis $n=2$; and let us make likewise $g=\sqrt{3}$ and $p=\sqrt{2}$, as in the primitive rhomboid of calcareous spar. Substituting these values in the expressions for fc and cz (Fig. 13.), we obtain $fc:cz::\sqrt{29}:\sqrt{3}$. This gives 144° 20′ 26″ for the inclination of fpd to bpd. Plate CCXXIV. Fig. 13.

If we substitute the same values in the expressions for de and ek, we obtain $de:ek::\sqrt{5}:\sqrt{3}$. This gives 104° 28′ 40″ for the inclination of fpd to fpq. But this is the angle which measures the inclination of the primitive faces $bafd$, $gafq$, which correspond to the secondary faces fpd and fpq.

Suppose $amhl$ (Fig. 14.) to be the four-sided figure which would be obtained by cutting the rhomboid as (Fig. 7.) by a plane passing through am and perpendicular to $abdf$. Draw ai (Fig. 14.) perpendicular to hm, and corresponding to the line ai (Fig. 7.) Figs. 7, 14.

It is easy to see, that the angle mal (Fig. 14.) measures the inclination of the two faces of the rhomboid taken round the same summit, and consequently it measures that of the rhombs $bofd$, $gofq$ (Fig. 7.) It remains only to prove, that the ratio of mr to ar (Fig. 14.), the sine and cosine of half that angle, is the same as that of de to ek (Fig. 13.)

We have had already am (Fig. 14.) $=\sqrt{\frac{4g^2p^2}{g^2+p^2}}=\sqrt{\frac{24}{5}}=mh$.

We have likewise had

$$ai=\sqrt{\frac{3g^2p^2-g^4}{p^2}}=\sqrt{\frac{9}{2}}.$$

But by construction $ml=2g=\sqrt{12}$. And $ar=\frac{ai\times mh}{ml}=\sqrt{\frac{\frac{9}{2}\times\frac{24}{5}}{12}}=\sqrt{\frac{9}{5}}$. Therefore $mr=g:ar::\sqrt{3}:\sqrt{\frac{9}{5}}::\sqrt{5}:\sqrt{3}::de$ (Fig. 13.) $:ek$, which was the point to be proved.

Let us now compare the solid angle f, formed by the three plane angles pfd, pfq, dfq, with the solid angle a of the nucleus. We have demonstrated, that the inclination of dpf to pfq, is equal to that of $bafd$ to $gafq$. Farther, the angles pfd, pfq are equal, as also the angles baf, gaf. And the angle dfq is equal to the angle bag. Hence the two solid angles are equal in every respect; and since bag is equal to each of the two other angles baf and gaf, it follows, that dfq is equal to each of the angles pfd, pfq. So that not only the inclination of the faces of the secondary crystal, adjacent to the edge pf, is equal to that of the

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corresponding faces of the nucleus, but likewise the obtuse plane angle of the faces of the secondary crystal is equal to that of the faces of the nucleus.

The preceding result furnishes us with a very simple method of obtaining the inclination of any one dpf of the faces of the dodecahedron to the adjacent face below the edge df. For that inclination is equal to that of dpf to $dfqs$ + the difference between this last and that of $bafd$ to $dfqs$. But the inclination of dpf to $dfqs$, is 104° 28′ 40″. That of $bafd$ to $dfqs$, the supplement to the preceding, is 75° 31′ 20″. The difference, of course, is 28° 57′ 20″. Adding this difference to 104° 28′ 40″, we obtain 133° 26′.

Plate CCXXIV. Figs. 13, 15.

Let $bafd$ (Fig. 15.) be the same rhomb as in Fig. 13. Draw by bisecting af. The triangle bay is similar to any one dpf (Fig. 13.) of the triangles of the secondary dodecahedron, so that the sides of the one are double those of the other.

Let us, in the first place, find the value of the three sides of the triangle dpf. We have

1. $df=\sqrt{g^2+p^2}=\sqrt{5}$.

2. dp (which is the same line as in Fig. 12.) $=\sqrt{\left(\frac{2n+1}{3n-3}\right)^2 a^2+\frac{4}{3}g^2}=\sqrt{\frac{25}{9}\cdot 9+4}=\sqrt{29}$.

3. pg (Fig. 12.) $=pg$ or pf (Fig. 13.) $=\sqrt{\left(\frac{n+2}{3n-3}\right)^2 a^2+\frac{4}{3}g^2}=\sqrt{\frac{16}{9}\cdot 9+4}=\sqrt{20}$.

Let us find, in like manner, the value of the three sides of the triangle bay (Fig. 15.)

1. $ay=\frac{1}{2}af=\frac{1}{2}\sqrt{5}=\frac{1}{2}df$ (Fig. 13.)

2. Having drawn ym perpendicular to bf (Fig. 15.), we have

$$by=\sqrt{(bm)^2+(my)^2}=\sqrt{(\tfrac{3}{4}bf)^2+(\tfrac{1}{2}ac)^2}$$
$$=\sqrt{\tfrac{9}{16}\cdot 12+\tfrac{1}{4}\cdot 2}=\tfrac{1}{2}\sqrt{29}=\tfrac{1}{2}dp \text{ (Fig. 13.)}$$

3. ab (Fig. 15.) $=\sqrt{5}=\frac{1}{2}\sqrt{20}=\frac{1}{2}pf$ (Fig. 13.)

We see likewise, that the mean side pf of the triangle dpf is double the small side. All these results take place in the variety of calcareous spar called *metastique* by Hauy.

This variety of crystal gives an opportunity of resolving another problem of considerable importance. It is to determine, from certain data, the ratio of the two semidiagonals g and p of the nucleus, from which the angles of the nucleus and of the secondary crystal may be calculated with rigid accuracy.

Let us employ, as data, the equality observed between the angles pfd and dfq (Fig. 13.), and the law of decrement by two ranges, from which the *metastatic* crystal results, or, if it is preferred, the equality of that part of the axis of the secondary crystal which passes the axis of the nucleus with that of the axis of the nucleus itself. Our object is, from these data, to find the ratio between g and p.

The angle pfd being equal to the angle dfq, or (which is the same thing) to the angle baf, the angles dfk and dfa, which are the supplements to these angles, are likewise equal. Then, since df is equal to af, the sine dk of the angle dfk will be equal to the sine am (Fig. 7.) of the angle dfk (Fig. 13.) But $am=\sqrt{\frac{4g^2p^2}{g^2+p^2}}$.

It remains for us to find dk, in order to form an equation with the value of am.

The triangle dek is rectangular at e; for the plane dfs being perpendicular to the plane afs, is perpendicular also to the plane pfs, which coincides with afs. Therefore, since de is at once situated in the plane dfs and perpendicular to fs, the common section of this plane with the plane pfs, it must be perpendicular likewise to this last plane. Therefore ke, situated in the prolongation of the plane pfs, and which falls upon de, will be perpendicular to this last line. Therefore the triangle dek is rectangular at e. Hence $dk=\sqrt{(de)^2+(ek)^2}$.

But $de=g$, and $ek=\frac{n}{n-1}\sqrt{\frac{\frac{1}{3}a^2g^2}{\left(\frac{n+2}{3n-3}\right)^2a^2+\frac{4}{3}g^2}}$. And because $n=2$, we have

$$ek=2\sqrt{\frac{\frac{1}{3}a^2g^2}{(\frac{4}{3})^2a^2+\frac{4}{3}g^2}}=\sqrt{\frac{3a^2g^2}{4a^2+3g^2}}.$$

Equating the values of the squares of dk and am, we have $\frac{7a^2g^2+3g^4}{4a^2+3g^2}=\frac{4g^2p^2}{g^2+p^2}$.

Substituting for a^2 its value $9p^2-3g^2$, it becomes

$$\frac{7g^2(9p^2-3g^2)+3g^4}{4(9p^2-3g^2)+3g^2}=\frac{4g^2p^2}{g^2+p^2}.$$

By making the two denominators disappear, by reducing and transposing, the expression becomes $g^4-\frac{9}{2}p^2g^2=-\frac{9}{2}p^4$.

This equation gives for the two values of g^2, $g^2=\frac{3}{2}p^2$, and $g^2=3p^2$.

In the first case, $g:p::\sqrt{3}:\sqrt{2}$. This is the ratio wanted between the semidiagonals of the primitive rhomboid. In the second case, we have $g:p::\sqrt{3}:1$. This corresponds with the hypothesis in which the nucleus and secondary crystal would be confounded under the same plane, which would be a regular hexagon.

There is another variety of calcareous spar, called *ascending* by Hauy, because the different laws on which it depends act from below upwards. Among its bounding faces, 12 result from a decrement on the inferior edges, and supposing them prolonged till they cut each other, they would give the form of a dodecahedron similar to the *metastatic*.

Suppose the triangles bpd, dpf, fpq represent three of the superior faces of this dodecahedron. If we measure the incidence of dpf or gpf, we find that it is nearly 101°. This makes us presume, at first, that it is equal to the great angle of the primitive rhomb, namely 101° 32′ 13″. Let us suppose this equality to hold true, and let us determine from thence the decrement, or the value of n.

We have by hypothesis $de:ek::g:p::\sqrt{3}:\sqrt{2}$.

But we formerly obtained

$$de:ek::\sqrt{\left(\frac{n+2}{3n-3}\right)^2a^2+\tfrac{4}{3}g^2}:\sqrt{\left(\frac{n}{n-1}\right)^2\tfrac{1}{3}a^2}.$$

Putting in place of a^2 its value 9, and of g^2 its value 3, we get

$$de:ek::\sqrt{\left(\frac{n+2}{3n-3}\right)^2 9+4}:\sqrt{\left(\frac{n}{n-1}\right)3}::\sqrt{3}:\sqrt{2}.$$

Taking the products of the extremes and means, and suppressing the radical signs, we get

$$\left(\frac{n+2}{3n-3}\right)^2 18+8=\left(\frac{n}{n-1}\right)^2 9;\text{ or,}$$
$$\frac{(n+2)^2 18+(3n-3)^2 8}{(3n-3)^2}=\left(\frac{n}{n-1}\right)^2 9;\text{ or,}$$
$$\frac{(n+2)^2 18+(3n-3)^2 8}{(3)^2}=9n^2.$$

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Getting rid of the denominator $(3)^2$, and developing the quantities $(n+2)^2$, $(3n-3)^2$, and dividing the whole by 9, the expression becomes $(n^2+4n+4)2+(n^2-2n+1)8=9n^2$. Hence we have $n^2-8n+16=0$. Consequently $n-4=0$ and $n=4$. So that the decrement takes place by four ranges.

With respect to the inclination of dpf to dpb, we obtain it by substituting for g, a, n, their values in the expression of the ratio of fc to cz. We will have $fc : cz :: \sqrt{\left(\frac{2n+1}{3n-3}\right)^2 a^2+\frac{4}{3}g^2} : \sqrt{\left(\frac{1}{n-1}\right)^2 \frac{1}{3}a^2} :: \sqrt{39} : \sqrt{3}$. This gives for the inclination sought 161° 48′ 18″.

Another property of this dodecahedron, supposing it complete, is, that the great angle dfp of its faces is a right angle.

To prove this, let us find the value of the three sides df, pf, and dp.

1. $df=\sqrt{g^2+p^2}=\sqrt{5}$.

Plate CCXXIV. Fig. 12, 13.

2. dp (Fig. 12.) $=\sqrt{\left(\frac{2n+1}{3n-3}\right)^2 a^2+\frac{4}{3}g^2}=\sqrt{\frac{81}{81}.9+4}=\sqrt{13}$.

3. pf (Fig. 13.) or its equal $p'g$ (Fig. 12.) $=\sqrt{\left(\frac{n+2}{3n-3}\right)^2 a^2+\frac{4}{3}g^2}=\sqrt{\frac{36}{81}.9+4}=\sqrt{8}$. Therefore (Fig. 13.) $(dp)^2=(pf)^2+(df)^2$. Of course the triangle dfp is rectangular in f.

4. *Decrements on the Lateral Angles.*

Decrements on the lateral angles.

The secondary forms produced by these decrements are usually dodecahedrons, in which three of the edges contiguous to each summit are parallel to the oblique diagonals which correspond to them in the nucleus.

Fig. 16.

Let ti (Fig. 16.) be one of these dodecahedrons, and to one of the edges parallel to the diagonals of the nucleus. Let b be the point of the edge tk which coincides with the lateral solid angle of the nucleus, or which is the point from which the decrement sets out. Let bc be the horizontal semidiameter of the rhomb upon which the same decrements act. Draw be perpendicular to to, and join the points c, e. Let bnm be the measuring triangle; and let g' be the horizontal semidiameter of a molecule. We will have $bn=2ng'$. As for nm, it coincides with the corresponding lateral face of the first plate of superposition, and measures the height of that face. Let as (Fig. 17.) be the nucleus represented separately in a position analogous to that which it has in the interior of the dodecahedron. A little attention will enable us to perceive that the lateral face which has been just mentioned, being contiguous to a range of edges of molecules, parallel to ag and ds, must be itself parallel to the principal section which passes through the points a, d, s, g. And since nm (Fig. 16.) measures the height of that lateral face, it will be equal to the height of a molecule, or to the line ak (Fig. 8.) supposing $adsg$ to represent the principal section of the molecule. Therefore we have

Fig. 17. Fig. 8. Plate CCXXII. Fig. 7.

nm (Fig. 7.) $=\sqrt{\frac{3g'^2p'^2-g'^4}{p'^2}}$. Therefore $bn : nm :: 2gn : \sqrt{\frac{3g^2p^2-g^4}{p^2}} :: 2n : \sqrt{\frac{3p^2-g^2}{p^2}}$, substituting g for g', and p for p', because the dimensions of the molecule are proportional to those of the nucleus.

Let us now obtain the respective inclinations of the faces of the dodecahedron, beginning with that of pto to kto. (Fig. 16.)

It is easy to perceive, that the angle bec is equal to half that inclination, and since the angle bce is a right angle, the two triangles bnm, bce are similar. Hence $bc : ce :: bn : nm :: 2gn : \sqrt{\frac{3g^2p^2-g^4}{p^2}} :: 2n . : \sqrt{\frac{3p^2-g^2}{p^2}}$.

Before calculating the second inclination, or that of otk to rtk, let us determine the portion of the axis of the dodecahedron which exceeds on each side the axis of the nucleus.

Plate CCXXIV. Fig. 18.

Let $adsg$ (Fig. 18.) be the principal section of the nucleus, to an edge of the secondary crystal parallel to the diagonal ad, and io the inferior edge contiguous to the preceding. From the point a, and from c, the centre of ad, draw ax and ce both perpendicular to to.

The similar triangles axt, aks give us $ak : as :: ax=ce : at$.

$$\text{But } ak=\sqrt{\frac{3g^2p^2-g^4}{p^2}}$$
$$as=\sqrt{9p^2-3g^2}.$$

Fig. 16.

ce, being the same line as in Figure 16, we have, $bc=g : ce :: 2gn : \sqrt{\frac{3g^2p^2-g^4}{p^2}}$. Therefore $ce=\frac{1}{2n}\sqrt{\frac{3g^2p^2-g^4}{p^2}}$.

Therefore the proportion becomes $\sqrt{\frac{3g^2p^2-g^4}{p^2}} : \sqrt{9p^2-3g^2} :: \frac{1}{2n}\sqrt{\frac{3g^2p^2-g^4}{p^2}} : at=\frac{1}{2n}\sqrt{9p^2-3g^2}$.

Fig. 19.

Let us suppose a plane oyr (Fig. 16.) perpendicular to the axis. Let oty, rty (Fig. 19.) be the portions of the triangles otk, rtk (Fig. 16.) cut off by this plane. Let tn be the corresponding part of the axis, which we shall suppose equal to tn, (Fig. 18.) Having drawn on, rn, and yn (Fig. 19.), we will have yn equal to gn (Fig. 18.), and on or rn (Fig. 19.) equal to nl (Fig. 18.), or to the prolongation of gn till it meet to.

Draw oz (Fig. 19.) perpendicular to ty, op perpendicular to ny, and join the points z, p. The angle ozp will measure half the inclination of otk (Fig. 16.) to rtk. Let us find expressions for the sine op (Fig. 19.) and the co-sine pz of the angle ozp.

1. For op. Because onp is an angle of 60°, or opn a right angle, $op=on\sqrt{\frac{3}{4}}$. But we must find the value of on or of its equal nl. (Fig. 18.) The similar triangles adr, tln give us $ar : dr :: tn : nl :: at+an : nl$. Or, $\frac{2}{3}\sqrt{a^2} : \sqrt{\frac{4}{3}g^2} :: \left(\frac{1}{2n}+\frac{1}{3}\right)\sqrt{a^2} : nl=\frac{2n+3}{2n}\sqrt{\frac{1}{3}g^2}=on$. Therefore $op=\frac{2n+3}{2n}\sqrt{\frac{1}{3}g^2}\times\sqrt{\frac{3}{4}}=\frac{2n+3}{4n}\sqrt{g^2}$.

2. For pz. The similar triangles tny, pzy (Fig. 19.) give $ty : tn :: py : pz$. Now

$$tn=\left(\frac{1}{2n}+\frac{1}{3}\right)\sqrt{a^2}=\frac{2n+3}{6n}\sqrt{a^2}.$$
$$ty=\sqrt{tn^2+yn^2}=\sqrt{\left(\frac{2n+3}{6n}\right)^2 a^2+\frac{4}{3}g^2}.$$
$$py=yn-pn=yn-\tfrac{1}{2}on=\sqrt{\tfrac{4}{3}g^2}-\frac{2n+3}{4n}\sqrt{\tfrac{1}{3}g^2}=\left(2-\left(\frac{2n+3}{4n}\right)\right)\sqrt{\tfrac{1}{3}g^2}=\frac{6n-3}{4n}\sqrt{\tfrac{1}{3}g^2}.$$

Mathematical Theory.

Hence the above proportion becomes

$$\sqrt{\left(\frac{2n+3}{6n}\right)^2 a^2 + \tfrac{4}{3} g^2} : \frac{2n+3}{6n}\sqrt{a^2} ::$$

$$\frac{6n-3}{4n}\sqrt{\tfrac{1}{3}g^2} : pz$$

$$= \frac{\frac{(2n+3)(6n-3)}{4n.6n}\sqrt{\tfrac{1}{3}a^2g^2}}{\sqrt{\left(\frac{2n+3}{6n}\right)^2 a^2 + \tfrac{4}{3}g^2}}.$$

Now, comparing op with oz, we obtain

$$op:oz::\sqrt{\left(\frac{2n+3}{6n}\right)^2 a^2 + \tfrac{4}{3}g^2} : \frac{2n-1}{2n}\sqrt{\tfrac{4}{3}a^2}.$$

PLATE CCXXIV. Fig. 16. Fig. 19.

Let $g=\sqrt{7}$, $p=\sqrt{3}$, as in the tourmaline; and let us suppose $n=1$, which indicates a decrement by two ranges. We will have, on the one part, bc (Fig. 16.) $:ce::\sqrt{6}:1$; which gives 135° 35′ 4″ for the inclination of pto on kto.

On the other part, we have op (Fig. 19.) $:pz::\sqrt{27}:1$, which gives 158° 12′ 48″ for the inclination of otk to rtk.

As the law of decrements varies, three of the longitudinal edges contiguous to each summit, such as to, tr, (Fig. 16.) preserve the same inclination to the axis, being always parallel to the oblique diagonals of the nucleus, while the three intermediate edges make greater or smaller angles with the axis, by rising up or sinking down. There is therefore a point, when the six edges, being equally inclined to the axis, become equal, so that the solid assumes the form of a dodecahedron composed of two right pyramids, united by their bases. Let us ascertain whether this result can be produced by a regular law of decrement.

Fig. 18.

It is evident that, in this case, gn (Fig. 18.) $= nl$, or $\sqrt{\tfrac{4}{3}g^2} = \frac{2n+3}{2n}\sqrt{\tfrac{1}{3}g^2}$. This equation gives us $n=\tfrac{3}{2}$. That is to say, that the decrement takes place by three ranges. Crystallization furnishes us with an example of this decrement in the faces, which form a kind of ring round the bases of a variety of corundum, called *uniternaire* by Haüy, and in those faces which are situated laterally in pairs in the *binoternary* variety of specular iron ore.

Let us ascertain if there be a case when the dodecahedron having its triangles, two and two, on the same plane, is converted into a rhomboid. At this point, the cosine pz (Fig. 18.) of the angle ozp vanishes. Assuming then the analytical expression for pz, and suppressing its denominator, we have $(2n+3)(6n-3)\sqrt{\tfrac{1}{3}a^2g^2}=0$; or simply, $6n-3=0$. This gives us $n=\tfrac{1}{2}$, which indicates a decrement by a single range of molecules.

Let us now ascertain, in a general manner, the relation between the two semidiagonals g' and p' of the secondary rhomboid.

We have on one side gn (Fig. 18.) $:tn::\sqrt{\tfrac{1}{3}g'^2}:\tfrac{1}{3}\sqrt{9p'^2-3g'^2}::\sqrt{g'^2}:\sqrt{3p'^2-g'^2}$.

On the other side, $gn:tn::\sqrt{\tfrac{4}{3}g^2}:\frac{2n+3}{6n}\sqrt{9p^2-3g^2}$ $=\tfrac{4}{3}\sqrt{9p^2-3g^2}$, because $n=\tfrac{1}{2}$.

Hence $g'^2:3p'^2-g'^2::\tfrac{4}{3}g'^2:\tfrac{4}{3}.\tfrac{4}{3}(9p^2-3g^2)::g^2:12p^2-4g^2$.

Taking the products of the extremes and means, and then reducing, we obtain

$12p^2g'^2-3g^2g'^2=3g^2p'^2$. From which we get this proportion, $g':p'::\sqrt{3g^2}:\sqrt{12p^2-3g^2}::\sqrt{g^2}:\sqrt{4p^2-g^2}$.

In calcareous spar, $g=\sqrt{3}$, $p=\sqrt{2}$. So that in it $g':p'::\sqrt{3}:\sqrt{5}$. That is to say, that the horizontal semidiagonal of the secondary rhomboid, is to the oblique, as the horizontal semidiagonal of the nucleus is to the edge of the same nucleus.

Another property of the secondary rhomboid, which we will consider here, consists in this. The plane angles are equal to the respective inclinations of the faces of the primitive rhomboid, and reciprocally. Farther, the angles of the principal section are the same on one side and the other.

Let us resume the formulæ relative to these three species of angles.

1. For the acute plane angle.

$$r:\text{Cos.}::g^2+p^2:\pm g^2\mp p^2.$$

2. For the smallest inclination of the faces.

$$r:\text{Cos.}::2p^2:\pm g^2\mp p^2.$$

3. For the acute angle of the principal section.

$$\text{Sin.}:\text{Cos.}::\sqrt{3g^2p^2-g^4}:\pm g^2\mp p^2.$$

But if we make $g=\sqrt{3}$, $p=\sqrt{2}$, as in the primitive rhomboid, and take the upper signs in the fourth term of the proportions, the first ratio becomes 5 : 1, the second 4 : 1, and the third 3 : 1.

And if we make $g=\sqrt{3}$, $p=\sqrt{5}$, as in the secondary rhomboid, and take the lower signs in the fourth term of the proportions, the first ratio becomes 4 : 1, the second 5 : 1, and the third 3 : 1. So that the third angles are the same; and with respect to the two others, they are the inverse of each other. This suggested the name *inverse calcareous spar*, by which Hauy has denoted this variety of crystal.

5. Decrements on the Inferior Angle.

Decrements on the inferior angle.

These decrements are analogous to those that take place on the superior angle, both because in general they produce rhomboids, and because they take place both in breadth and in height. In the first case, the faces produced incline towards the superior part of the axis; in the second, they incline the contrary way, or towards the inferior part of the axis. We shall consider, in the first place, the decrements in breadth.

PLATE CCXXIV. Fig. 20.

Let $adsg$ (Fig. 20.) be the principal section of the nucleus, pd the oblique diagonal of the secondary rhomboid, and ud the inferior edge contiguous to that diagonal. The measuring triangle dho will not differ from that which has been already considered in the case of decrements on the inferior edges, (Fig. 12.) We have, in the present case, dh (Fig. 20.) $:oh::2np:\sqrt{g^2=p^2}$. The only difference will be, that the number of diagonals subtracted, which in the preceding case was equal to the number of ranges subtracted, in the present case will only be equal to half that number.

By proceeding in the same way as in the case alluded to, we shall have $ap=\frac{1}{n-1}\sqrt{9p^2-3g^2}$ and $pr=\frac{2n+1}{3n-3}\sqrt{9p^2-3g^2}$.

Let us now ascertain the general expression for the ratio of the two semidiameters g' and p' of the secondary rhomboid.

Let tz be the semiperpendicular to the axis relative to this rhomboid. We shall have

$tz:pz::dr:pr::\sqrt{\tfrac{4}{3}g^2}:\frac{2n+1}{3n-3}\sqrt{9p^2-3g^2}::\sqrt{\tfrac{1}{3}g'^2}:\tfrac{1}{3}\sqrt{9p'^2-3g'^2}$.

Mathematical Theory.

And simplifying

$$4g^2 : \left(\frac{2n+1}{n-1}\right)^2 (3p^2-g^2) :: g'^2 : 3p'^2-g'^2.$$

Taking the products of the extremes and means, getting rid of the denominator $(n-1)^2$, and transposing, we obtain this equation.

$(2n+1)^2 3p^2 g'^2 + (n-1)^2 4g^2 g'^2 - (2n+1)^2 g^2 g'^2 = (n-1)^2 12 g^2 p'^2.$

Developing the quantities $(n-1)^2$, $(2n+1)^2$, and reducing, we get $(2n+1)^2\ p^2 g'^2 + (1-4n) g^2 g'^2 = (n-1)^2 4 g^2 p'^2$, which gives us this proportion,

$$g' : p' :: \sqrt{(n-1)4g^2} : \sqrt{(2n+1)^2 p^2 + (1-4n)g^2}$$

Let $g=\sqrt{3}$, $p=\sqrt{2}$, as in calcareous spar; and let us suppose $n=\frac{1}{2}$. We will get

$$g' : p' :: \sqrt{3} : \sqrt{17}.$$

Such is the ratio of the semidiameters in the variety of calcareous spar called *contrasting* by Hauy.

If in the formula $a\,p = \frac{1}{n-1}\sqrt{9p^2-3g^2}$ we make $n=1$, we get $a\,p = \frac{1}{0}\sqrt{9p^2-3g^2}$, as we did for the decrements on the inferior edges, with this difference, that the vertical faces result from a decrement by two ranges. This case holds in the regular six-sided prism of calcareous spar.

Plate CCXXIV. Fig. 21.

Let us now proceed to the decrements which take place in height on the same angle. Let $o\,u$ (Fig. 21.) be one of the oblique diagonals of the secondary rhomboid, and $o\,p$ the adjacent edge, from which we see that the first of these lines corresponds with the edge $d\,s$ of the nucleus, and the second with the oblique diagonal $a\,d$. Let $d\,h\,e$ be the measuring triangle, in which $d\,h : e\,h :: p : n\sqrt{g^2+p^2}$. Let us, in the first place, find an expression for $a\,p$.

Produce $a\,d$ to l. The triangles $p\,a\,l$, $p\,s\,g$, being similar, we have $g\,s : a\,s + a\,p :: a\,l : a\,p$. But

$$g\,s = 2\,p$$
$$a\,s = \sqrt{9p^2-3g^2}.$$

We must find the value of $a\,l$. The similar triangles $g\,a\,l$, $d\,h\,e$, give us $e\,h : d\,h :: g\,a : a\,l$, or $n\sqrt{g^2+p^2} : p :: \sqrt{g^2+p^2} : a\,l = \frac{p}{n}$.

The above proportion $g\,s : a\,s + a\,p :: a\,l : a\,p$ becomes therefore $2\,p : \sqrt{9p^2-3g^2} + a\,p :: \frac{p}{n} : a\,p$. Hence we have $a\,p = \frac{1}{2n-1}\sqrt{9p^2-3g^2} = u\,s$. From this we may conclude, that $d\,r : u\,r :: \sqrt{\frac{4}{3}g^2} : \left(\frac{1}{2n-1}+\frac{1}{3}\right)\sqrt{9p^2-3g^2} :: \sqrt{\frac{4}{3}g^2} : \left(\frac{2n+2}{6n-3}\right)\sqrt{9p^2-3g^2}.$

Let us ascertain the ratio between the diagonals g' and p' of the secondary rhomboid.

The semiperpendicular on the axis of this rhomboid is to the third of that axis as $d\,r : u\,r$.

Therefore

$$\sqrt{\tfrac{4}{3}g^2} : \frac{2n+2}{6n-3}\sqrt{9p^2-3g^2} :: \sqrt{\tfrac{4}{3}g'^2} : \tfrac{1}{3}\sqrt{9p'^2-g'^2}.$$

Simplifying and getting rid of the radical signs, this proportion becomes $(2n-1)^2\, 4g^2 : (2n+2)^2\ (3p^2-g^2) :: g'^2 : 3p'^2-g'^2$.

Taking the products of the extremes and means, transposing and dividing by two, we get this equation; $(n+1)^2 3p^2 g'^2 + (2n-1)^2 g^2 g'^2 - (n+1)^2 g^2 g'^2 = (2n-1)^2 3 g^2 p'^2.$

Developing the quantities $(2n-1)^2$, $(2n+1)^2$, and reducing

$(n+1)^2 3p^2 g'^2 + (3n^2-6n) g^2 g'^2 = (2n-1)^2 3 g^2 p'^2.$

Hence we obtain this proportion,

$$g' : p' :: \sqrt{(2n-1)^2 3g^2} : \sqrt{(n+1)^2 3p^2 + (3n^2-6n)g^2}.$$

There is a variety of calcareous spar so nearly cubic, that it was distinguished by the epithet. It is not, however, an exact cube, the faces differing about two degrees from being rectangular. Let us see how we may determine the law of decrement which takes place in this variety, knowing the angles of the faces.

The solid being a little more acute than a cube, it follows that the ratio $d\,r : u\,r$, which results from the law that produces it, must be a little greater than that of $1 : \sqrt{2}$ which exists in the cube. It must at the same time be commensurable. But if we substitute successively for the ratio $1 : \sqrt{2}$, the equal ratios $\sqrt{2} : \sqrt{4}$, $\sqrt{3} : \sqrt{6}$, $\sqrt{4} : \sqrt{8}$, we perceive that it is sufficient, in this last expression, to increase the number 8 by unity, changing it into $\sqrt{4} : \sqrt{9}$, to have the commensurable ratio $2 : 3$, which will be a little greater than the former. Let us therefore try this ratio, and suppose $d\,r : u\,r :: 2 : 3$, or

$$\sqrt{\tfrac{4}{3}g^2} : \frac{2n+2}{6n-3}\sqrt{9p^2-3g^2} :: 2 : 3.$$

And because $g=\sqrt{3}$, and $p=\sqrt{2}$, we have

$$2 : \left(\frac{2n+2}{6n-3}\right) 3 :: 2 : 3.$$

From this we obtain $6n-3 = 2n+2$ and $n=\frac{5}{4}$. Therefore, since n expresses the number of ranges subtracted in height, the decrement takes place by 4 ranges in breadth and 5 in height.

Let us ascertain, according to the same hypothesis, the ratio between the semidiameters g' and p'. We have had already

$$g' : p' :: \sqrt{(2n-1)^2 3g^2} : \sqrt{(n+1)^2 3p^2 + (3n^2-6n)g^2}.$$

And making $n=\frac{5}{4}$, $g=\sqrt{3}$, $p=\sqrt{2}$, we have

$$g' : p' :: \sqrt{\tfrac{9}{4}.3.3} : \sqrt{\tfrac{81}{16}.3.2 - \tfrac{45}{16}.3} :: \sqrt{12} : \sqrt{13}.$$

This gives us the smallest inclination of the faces 87° 47′ 45″, which is conformable to observation.

Let us now enquire whether, among all the possible secondary rhomboids, there be one which is similar to the nucleus. In such a case $g' : p' :: g : p$. Substituting the second ratio for the first in the proportion given above, we will have $g : p :: \sqrt{(2n-1)^2 3g^2} : \sqrt{(n+1)^2 3p^2 + (3n^2-6n)g^2}$. From this, getting quit of the radical signs and developing the quantities $(2n-1)^2$, $(n+1)^2$, we obtain

$3n^2p^2 + 6np^2 + 3p^2 + 3n^2g^2 - 6ng^2 = 12n^2p^2 - 12np^2 + 3p^2.$

And reducing, $n^2(3p^2-g^2) = n(6p^2-2g^2)$. This gives us $n=2$. Hence we learn that the result in question may take place in consequence of a decrement by two ranges in height.

If we compare the ratio $d\,r : p\,r$, or $\sqrt{\frac{4}{3}g^2} : \frac{2n+1}{3n-3}\sqrt{9p^2-3g^2}$, with the ratio $d\,r : u\,r$ (Fig. 21.), or $\sqrt{\frac{4}{3}g^2} : \frac{2n+2}{6n-3}\sqrt{9p^2-3g^2}$, ratios the first of which is for decrements in breadth, and the second for decrements in height; we find that they differ only by the quantity, which in the second term multiplies the expression for the axis, and which in the first is $\frac{2n+1}{3n-3}$, and in the second $\frac{2n+2}{6n-3}$. Let us change n in this last expression into n', and let us equate the two, making

Plate CCXXIV. Fig. 21.

Mathematical Theory.

$\frac{2n+1}{3n-3}=\frac{2n'+2}{6n'-3}$. From this equation we get $n=\frac{4n'+1}{4-2n'}$, and $n'=\frac{4n-1}{2n+4}$. Therefore, since the values of n and n' are rational numbers, it follows, that the same form of rhomboid which is possible in consequence of a certain law of decrement in breadth, is possible also by a different decrement in height, and *vice versa*. We may always pass from the one to the other, in consequence of the preceding formulas.

Suppose, for example, we inquire what would be the decrement in breadth which would produce a secondary rhomboid similar to the cuboid. To resolve this question, we have only to take the formula $n=\frac{4n'+1}{4-2n'}$, and make $n'=\frac{5}{4}$. This gives us $n=4$. Hence the law sought would be a decrement by 8 ranges of molecules.

On Intermediate Decrements relative to the Rhomboid.

Intermediate decrements relative to the rhomboid.

The decrements called *intermediate*, depend upon two variable elements which must enter into their calculation. The one is the ratio between the number of lengths of molecules, subtracted from the two sides of the angle on which the decrement takes place. The other is the number of ranges subtracted, or the distance between the same angle and the edge of the first plate of superposition. The fraction $\frac{y}{x}$ represents the ratio between the sides; and n, as usual, denotes the number of ranges subtracted.

In proportion as y diminishes in relation to x, the edge of each plate inclines always more towards the edge of which x constitutes a part, and when y vanishes it coincides with that edge. On the other hand, in proportion as y augments in relation to x, the edge of each plate of superposition becomes more nearly parallel to the diagonal opposite to the angle on which the decrement takes place; and when y becomes equal to x, we have the ordinary decrement on the angles.

Plate CCXXIV. Fig. 22.

Let us consider, in the first place, the effects of an intermediate decrement towards the lateral angles b, u, (Fig. 22.) of any rhomboid, one of the superior faces of which is represented by $a\,b\,d\,u$. Let us suppose $\gamma\lambda$ to be the edge of the first plate of superposition, so that $b\,\gamma$, $b\,\lambda$, measure the respective lengths of molecules on the edges, with this single condition, that $b\,\lambda$ or x is always greater than $b\,\gamma$ or y.

Fig. 23. Fig. 24.

In that case, the secondary solid will be in general a dodecahedron, HX, (Fig. 23.) with triangular faces. Let $a\,g\,s\,d$ (Fig. 24.) be the principal section of the nucleus, and $h\,x$ the axis of the secondary crystal. It is easy to see that of two contiguous edges, such as hq, qx, the first passes though the angle d, while the other is formed at a certain distance above the diagonal $a\,d$. Draw $d\,p$ parallel to this last edge; $d\,p$ will be situated as the oblique diagonal of a rhomboid resulting from a decrement on the angle d, in which the distance of one plate from another, taken in the direction $d\,a$, will be the same as in the dodecahedron that we are now considering. Let dkf be the measuring triangle referred to the plane $p\,d\,r$. kf will represent the length of one molecule. Let us find an expression for $d\,k$.

Draw $\lambda\,\mu$ (Fig. 22.) parallel to $d\,a$; $\gamma\pi$ perpendicular to $\lambda\,\mu$; $d\,\varepsilon$ parallel to $\gamma\,\lambda$; then taking $\varepsilon\,\vartheta$ equal to $b\,\gamma$, draw $\vartheta\,\nu$ parallel to $d\,\varepsilon$, and $\nu\,\varphi$ parallel to $a\,b$. It is evident that $d\,\varepsilon$, $\nu\,\vartheta$ will correspond with the edges of the consecutive plates of superposition; and of course $d\,\nu$ will be the distance of one plate from another, taken in the direction $d\,a$, supposing always only one range subtracted. Therefore we have $d\,\nu \times n = d\,k$ (Fig. 24.). The question is therefore reduced to find an algebraic expression for $d\,\nu$ (Fig. 22.)

Plate CCXXIV. Fig. 22.

But $\lambda\,\mu$ measures as many times the oblique semidiagonal of a molecule, as there are lengths of a molecule contained in $b\,\lambda + b\,\mu = 2\,x$. Therefore denoting by p' the oblique semidiagonal of a molecule, we may represent $\lambda\,\mu$ by $2\,p'x$. On the other side $\omega\,\nu = \varepsilon\,\vartheta = b\,\gamma = y$. But the similar triangles $\omega\,\nu\,d$, $\gamma\,\mu\,\lambda$ give $\gamma\,\mu : \lambda\,\mu :: \omega\,\nu : d\,\nu$; or, $x-y : 2\,p'x :: y : d\,\nu = \frac{2\,p'x\,y}{x-y}$. Therefore $d\,k$ (Fig. 24.) $= \frac{2\,p'\,n\,x\,y}{x-y}$. Therefore, denoting by g' the horizontal semidiagonal of a molecule, we will have $d\,k : k\,f :: \frac{2\,p'n\,x\,y}{x-y} : \sqrt{g'^2+p'^2}$. Or, since the dimensions of the molecule are proportional to those of the nucleus $d\,k : k\,f :: \frac{2\,p\,n\,x\,y}{x-y} : \sqrt{g^2+p^2}$.

Let us now determine the respective incidences of the neighbouring faces towards the same summit of the dodecahedron HX (Fig. 23.), in which the edge QX is conceived to be the same as $q\,x$ (Fig. 24.)

Let us begin with the incidence of CXQ (Fig. 23.) on NXQ. Let $b\,u$ be one of the horizontal diagonals of the nucleus, and $b\,a\,u$, one half of the rhomb to which that diagonal belongs. Let $b\,r$, $u\,y$ be sections of the same rhomb, prolonged for the purpose on the triangles CXQ, NXQ. If we prolong these sections till they meet in a common point m, the triangle $b\,m\,o$ will be similar to the triangle $\gamma\,\lambda\,\pi$ (Fig. 22.), since $b\,m$, $u\,m$ (Fig. 23.), or their parts $b\,r$, $u\,y$, of necessity represent the two decreasing faces of the same plate of superposition.

Draw $b\,n$ perpendicular to QX (Fig. 23). Then join the points o, n. The angle $b\,n\,o$ will be the half of that which measures the incidence of CXQ or NXQ. We must therefore find the relation between the sine $b\,o$ and the cosine $o\,n$ of the angle $b\,n\,o$. But $b\,o = g$. We have only therefore to find $o\,n$.

From the point o (Fig. 24.) in the centre of $a\,d$, and from the point a, draw the lines $o\,n$, $a\,b$ perpendicular to $q\,x$, and produce $g\,a$ till it meets $d\,p$. The line $o\,n$ is the same as $o\,n$ (Fig. 23.). Let us find its algebraic expression.

The triangles $m\,o\,n$, (Fig. 23.) and $d\,o\,z$, (Fig. 24.) are similar, since om (Fig. 23.) coincides with od, (Fig. 24.) $o\,n$ with $o\,z$, and $d\,p$, (Fig. 24.) of which $d\,z$ is a part, is parallel to m X, (Fig. 23.) on which $m\,n$ is situated. Therefore $om : on$ (Fig. 23.) $:: od : oz$ (Fig. 24.) $:: a\,d : a\,l$. Hence to find $o\,n$, we must find $o\,m$, $a\,d$, and $a\,l$. But $a\,d = 2\,p$. We have only therefore to find $o\,m$ and $a\,l$.

1. For $o\,m$. The triangles $\gamma\,\pi\,\lambda$ (Fig. 22.) and $b\,o\,m$ (Fig. 23.) are similar, as has been already observed. Therefore $\gamma\pi : \pi\,\lambda :: bo : om$. But $\pi\,\lambda$ measures as many demidiagonals p as there are lengths contained in $b\,\lambda + b\,\gamma = x+y$; and $\gamma\pi$ measures as many demidiagonals g as there are lengths contained in $\gamma\mu = x-y$. Hence $\gamma\pi : \pi\,\lambda :: gx-gy : px+py :: bo$ (Fig. 23.) $: om :: g : om$. Hence we obtain $o\,m = \frac{p\,x+p\,y}{x-y}$.

2. For $a\,l$ (Fig. 24.). The triangles $a\,l\,p$, $d\,r\,p$ give us $a\,p : a\,l :: d\,p : d\,r$. But $d\,r = \sqrt{\frac{4}{3}\,g^2}$. We have only then to find $a\,p$ and $d\,p$.

Mathematical Theory.

(1.) For ap. The triangles pay, psd give us $ap : ay :: ap+as : ds$. But $as=\sqrt{a^2}$; $ds=\sqrt{g^2+p^2}$. To obtain an expression for ay, we have (from the similar triangles dkf, day) $dk : fk :: da : ay$. Or, $\frac{2pnxy}{x-y} : \sqrt{g^2+p^2} :: 2p : ay=\frac{x-y}{nxy}\sqrt{g^2+p^2}$.

Hence the proportion $ap : ay :: ap+as : ds$ becomes $ap : \frac{x-y}{nxy}\sqrt{g^2+p^2} :: ap+\sqrt{a^2} : \sqrt{g^2+p^2}$.

Hence we obtain $ap=\left(\frac{x-y}{nxy}\right)ap+\frac{x-y}{nxy}\sqrt{a^2}$; and finally, $ap=\frac{x-y}{nxy-x+y}\sqrt{a^2}$.

(2.) For dp. We have $dp=\sqrt{(pr)^2+(dr)^2}$. But $(dr)^2=\frac{4}{3}g^2$. We have only therefore to obtain pr, in order to have an expression for dp.

Now $pr=ap+ar=\left(\frac{x-y}{nxy-x+y}+\frac{2}{3}\right)\sqrt{a^2}=\frac{2nxy+x-y}{3nxy-3x+3y}$.

Therefore $dp=\sqrt{\left(\frac{2nxy+x-y}{3nxy-3x+3y}\right)^2a^2+\frac{4}{3}g^2}$. Of consequence, the proportion $ap : al :: dp : dr$ will become

$$\frac{x-y}{nxy-x+y}\sqrt{a^2} : al :: \sqrt{\left(\frac{2nxy+x-y}{3nxy-3x+3y}\right)^2a^2+\frac{4}{3}g^2} : \sqrt{\frac{4}{3}g^2}.$$

Thus we get $al=\dfrac{\frac{x-y}{nxy-x+y}\sqrt{\frac{4}{3}a^2g^2}}{\sqrt{\left(\frac{2nxy+x-y}{3nxy-3x+3y}\right)^2a^2+\frac{4}{3}g^2}}$.

Resuming the original proportion $om : on :: ad : al$, and substituting the values thus found, the proportion becomes

$$\frac{px+py}{x-y} : on :: 2p : \frac{\frac{x-y}{nxy-x+y}\sqrt{\frac{4}{3}a^2g^2}}{\sqrt{\left(\frac{2nxy+x-y}{3nxy-3x+3y}\right)^2a^2+\frac{4}{3}g^2}}.$$

This proportion gives us

$$on=\frac{\frac{x-y}{nxy-x+y}\sqrt{\frac{1}{3}a^2g^2}}{\sqrt{\left(\frac{2nxy+x-y}{3nxy-3x+3y}\right)^2a^2+\frac{4}{3}g^2}}.$$

Therefore $bo : on :: g :$ *the preceding fraction.* And getting rid of the denominator of that fraction, and dividing by g, we finally obtain $bo : on :: \sqrt{\left(\frac{2nxy+x-y}{3(nxy-x+y)}\right)^2a^2+\frac{4}{3}g^2} : \frac{x+y}{nxy-x+y}\sqrt{\frac{1}{3}a^2} :: \sqrt{\frac{1}{3}(2nxy+x-y)^2a^2+(nxy-x+y^2)4g^2}\,\sqrt{a^2} : (x+y)\sqrt{a^2}$.

Nothing more would be necessary than this ratio, and the law of decrement, to determine the accurate figure of those kind of crystals which we are considering. But an example may be necessary to make the method obvious to beginners.

Let us suppose that HX (Fig. 23.) represents that variety of carbonate of lime called *paradoxal* by Hauy. If we attempt to divide this crystal mechanically, we find that each section, such as $\varepsilon\delta\zeta$, commences from one of the shortest edges, and rises in such a manner that the angle δ contiguous to the edge QX is about 45°.

PLATE CCXXIV. Fig. 23.

This being understood, draw the rhomb $ab\delta u$ (Fig. 25.) similar to the primitive rhomb, and, from the point δ, draw $\delta\varepsilon$, $\delta\zeta$, each of which makes with the diagonal $a\delta$ an angle of $22\frac{1}{2}$°. It is evident that these two lines represent the position of the two decreasing edges of the same plate, so that $b\varepsilon$ and $b\delta$ are to each other as the number of lengths of molecules subtracted from the two sides of the angle on which the decrement takes place. But, on comparing these two lines, we find that $b\delta$ is apparently double of $b\varepsilon$. Hence we conclude, that in the preceding formula $x=2$ and $y=1$. As we are ignorant of the value of n, we give it at first the most simple value, making $n=1$. We know already that $a^2=9$ and $g^2=3$. Substituting these values in the preceding formula, we obtain $bo : on :: \sqrt{29} : \sqrt{27}$. This gives 92° 3′ 10″ for the incidence of CXQ on NXQ. But this measure agreeing with observation, we conclude, that the decrement really takes place by the subtraction of one range of double molecules.

Mathematical Theory. PLATE CCXXIV. Fig. 25.

To determine the incidence of CXB or CXQ, we must have an expression for hr. (Fig. 24.)

But $hr=ux=ax+au=ap+px+au$. Now $ap=\frac{x-y}{nxy-x+y}\sqrt{a^2}$; and $au=\frac{1}{3}\sqrt{a^2}$. We have only therefore to find px.

The similar triangles bax, lap give us $al : bl :: ap : px$. But $bl=nz=on-oz=on-\frac{1}{2}al$. So that the proportion becomes $al : on-\frac{1}{2}al :: ap : px$. But we found formerly, that

$$al=\frac{\frac{x-y}{nxy-x+y}\sqrt{\frac{4}{3}a^2g^2}}{\sqrt{\left(\frac{2nxy+x-y}{3nxy-3x+3y}\right)^2a^2+\frac{4}{3}g^2}} \text{ and}$$

$$on=\frac{\frac{x+y}{nxy-x+y}\sqrt{\frac{1}{3}a^2g^2}}{\sqrt{\left(\frac{2nxy+x-y}{3nxy-3x+3y}\right)^2a^2+\frac{4}{3}g^2}}.$$

From these values we see that al and on are equal, the first to $(x-y)\sqrt{4}$ or to $2x-2y$; the second to $x+y$; multiplied each by the same fraction. We may therefore state the proportion as follows:

$$2x-2y : x+y-x+y :: \frac{x-y}{nxy-x+y}\sqrt{a^2} : px.$$

This gives us $px=\frac{y}{nxy-x+y}\sqrt{a^2}$.

Therefore we have at last

$$hr=\left(\frac{x-y}{nxy-x+y}+\frac{y}{nxy-x+y}+\frac{1}{3}\right)\sqrt{a^2}=\frac{nxy+2x+y}{3(nxy-x+y)}\sqrt{a^2}.$$

Let us now conceive a plane, which, passing through some point of the edge CX (Fig. 23.) is perpendicular to the axis HX. Let qxv, bxv (Fig. 1.) be the two portions of the faces BXC, QXC (Fig. 23.) intercepted by this plane. For the greater simplicity, let us suppose that the plane passes at such a distance from the summit, that the part xr (Fig. 1.) which it intercepts on the axis, is equal to pr (Fig. 24.) In that case, qr (Fig. 1.) or br will be equal to dr (Fig. 24.)

PLATE CCXXV. Fig. 1.

Having drawn pt (Fig. 24.) parallel to qx, produce dr till it meet pt. The line vr (Fig. 1.) will be equal to rt (Fig. 24.)

We have then xr (Fig. 1.) $=\frac{2nxy+x-y}{3nxy-3x+3y}\sqrt{a^2}$

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and $qr=\sqrt{\frac{4}{3}g^2}$. Let us find an expression for vr or its equal rt (Fig. 24.) The similar triangles prt, hrd give $hr:dr::pr:rt$; or $\frac{nxy+2x+y}{3nxy-x+y)}\sqrt{a^2}:\sqrt{\frac{4}{3}g^2}::\frac{2nxy+x-y}{3nxy-x+y)}\sqrt{a^2}:rt=\frac{2nxy+x-y}{nxy+2x+y}\sqrt{\frac{4}{3}g^2}=vr$ (Fig. 1.)

PLATE CCXXIV. Fig. 24.

Join bq; then draw qz perpendicular to vx. Draw also lz. The angle qzl will be the half of that which measures the incidence of qxv on bxv, or of QXC (Fig. 23.) on BXC. But it is easy to have the ratio between ql (Fig. 1.) and lz in values of qr, xr and vr, by a method formerly explained. By that method $ql=\frac{qr}{2}\sqrt{3}$. We obtain lz by means of this proportion $vx:xr::vl:lz$; or $\sqrt{(xr)^2+(vr)^2}:xr::vr-rl:lz::vr-\frac{1}{2}qr:lz$. Hence we get $lz=xr\frac{(vr-\frac{1}{2}qr)}{\sqrt{(xr)^2+(vr)^2}}$.

PLATE CCXXV. Fig. 1.

Hence $ql:lz::\frac{qr}{2}\sqrt{3}:\frac{xr(vr-\frac{1}{2}qr)}{\sqrt{(xr)^2+(vr)^2}}::$

$qr\sqrt{3\left((xr)^2+(vr)^2\right)}:xr(2vr-qr)$. But if we make $g=\sqrt{3}$, $p=\sqrt{2}$, $n=1$, $x=2$, $y=1$, in the algebraic expressions for qr, xr, and vr given above, we get $qr=2$, $xr=5$, $vr=\frac{10}{7}$. Substituting these values, instead of qr, xr, vr, in the ratio of ql to lz, we get $ql:lz::2\sqrt{3\left(25+\frac{100}{49}\right)}:5\left(\frac{20}{7}-2\right)::\sqrt{53}:\sqrt{3}$. This gives us for the incidence of CXB upon CXQ (Fig. 23.) 153° 13′ 58″.

These observations and illustrations will give the reader a pretty accurate idea of the method of proceeding in cases of intermediate decrements. A complete discussion of the subject would swell to a greater length than would be tolerated in a work of this kind. Indeed, we are afraid that we have already extended this Chapter farther than many readers will be disposed to follow us. Those persons who wish to see the intermediate decrements explained at full length, with all the requisite examples, may consult Hauy's *Mineralogie*, vol. i. p. 357. where they will meet with ample satisfaction.

Of the Compound Secondary Forms relative to the Rhomboid.

Compound secondary forms relative to the rhomboid.

The compound secondary forms, especially those which have a rhomboid for a nucleus, are usually nothing else than a combination of several simple forms, which have often a separate existence in particular varieties of the same substance. When the faces belonging to each of these simple forms are sufficiently near each other, and of sufficient size to admit the measurement of their mutual incidences, the compound form may be determined by the calculation of these incidences alone, which is always easy and simple. But it is sometimes necessary, and often useful, to be able to measure the incidences of the faces of one order on those of another order. There are even cases when it becomes interesting to know the plane angles of these faces. To be able to resolve these problems, it is necessary to be accustomed to conceive and to determine the results of the intersections of different planes inclined in different directions. But in the rhomboid we have this advantage, that the determination may be made analytically from the ratios between the quantities which represent the system of lines relative to this kind of solid.

We shall satisfy ourselves with a single example, and we shall select the variety of carbonate of lime called *analogie* by Hauy.

This variety is derived from the *prismatic* carbonate, by its six vertical faces, from the *metastatic* carbonate by its twelve faces, situated six and six on each side of the six vertical faces, and from the *equiaxe* carbonate by its terminal faces, to the number of three at each extremity. These different faces are situated so advantageously, that the knowledge of the angles which the faces of the same order make with each other, (supposing the structure of the forms from which they are derived known) is sufficient to verify the laws upon which the crystal depends. But without any regard to this knowledge, let us endeavour, in the first place, to determine the plane angles of the different faces, and then the incidences of the faces of one order upon those of another.

Let $criz$ (Fig. 2.) be one of the vertical faces, $c\gamma pr$, $c\varepsilon sz$, two of the faces that belong to the metastatic variety, and $\gamma c\varepsilon\mu$ one of the faces derived from the equiaxe. PLATE CCXXV. Fig. 2.

Let dof, qof, duf, quf be four faces of the metastatic variety, supposed complete. Draw the axis ou, the two diagonals ci, rz of the trapezoid $criz$, the great diagonal γr of the trapezoid $c\gamma pr$, and the two diagonals $c\mu$, $\gamma\varepsilon$ of the trapezoid $\gamma c\varepsilon\mu$.

Let us begin with $criz$. The points r, z being situated in the middle of the edges df, qf which are common to the metastatic crystal and to the nucleus, it is obvious that $rz=g=\sqrt{3}$. Of course $rh=\sqrt{\frac{3}{4}}$. Let h (Fig. 3.) be the same point as in (Fig. 2.) If we draw hc (Fig. 3.) parallel to the axis, that line will likewise be the same as the line marked with the same letters in Fig. 2. But the point h (Fig 3.) is situated at $\frac{1}{4}$th the oblique diagonal ft. Hence $fh=\frac{1}{2}p$. But $fh:ft::hc:to$. And $to=2a=6$. So that the proportion becomes $\frac{1}{2}:2::hc:6$. This gives us $hc=\frac{3}{2}$. Therefore (Fig. 2.) $rh:hc::\sqrt{\frac{3}{4}}:\frac{3}{2}::1:\sqrt{3}$. Hence the triangle rcz is equilateral. Fig. 3.

Again, hi (Fig. 3.) is equal to the same line in (Fig. 2.) and from comparing the similar triangles fhi, ftu (Fig. 3.) it appears that $hi=\frac{1}{4}tu=\frac{3}{4}$. Hence hi (Fig. 2.) $=\frac{1}{2}hc$. From these data it follows, that $rcz=60^\circ$, cri or $czi=100^\circ\ 53'\ 37''$, $riz=98^\circ\ 12'\ 46''$.

Let us determine, in the second place, the trapezoid $\gamma c\varepsilon\mu$. Let ou, of, uf, $c\mu$ (Fig. 4.) be the same lines as in Fig. 2. Through the point ζ (Fig. 4.) the same as in Fig. 2.; draw $o\zeta$ (Fig. 4.) and prolong it indefinitely.* This line is evidently in the plane $\gamma o\varepsilon$ (Fig. 2.) or, which comes to the same thing, in the plane doq. Therefore it passes through the middle of the diagonal which joins d, q. Let ϑ (Fig. 4.) be that middle point. Draw $\vartheta\varphi$, $c\sigma$, $\zeta\nu$ perpendicular to the axis, and $\zeta\tau$ perpendicular to $c\sigma$. It may be shewn as follows, that $c\zeta=2\zeta\mu$. Fig. 4.

The similar triangles $c\tau\zeta$, $c\sigma\mu$, give us $c\tau:\tau\sigma::c\zeta:\zeta\mu$. Hence it is clear, that $c\zeta=2\zeta\mu$, provided it can be proved that $c\tau=2\tau\sigma$. For this purpose, let us determine the values of $c\tau$ and $\tau\sigma$.

1. For $c\tau$. $c\tau=c\lambda+\lambda\tau$, and $c\lambda=c\sigma-\sigma\lambda$.

To obtain a value of $\sigma\lambda$, let us observe that the line $\vartheta\varphi$ being the demiperpendicular to the axis in relation

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Plate CCXXV. Fig. 3, 4.

to one of the inferior rhombs of the nucleus, its position is the same as gn (Fig. 3.) Therefore $o\phi$ (Fig. 4.) $= og$ (Fig. 3.) $= oa + ag = 3 + 2 = 5$. Farther, $\vartheta\phi$ (Fig. 4.) $= \sqrt{\frac{1}{3}g^2} = 1$. Now the similar triangles $o\sigma\lambda$, $o\phi\theta$, give $o\sigma : \sigma\lambda :: o\phi : \phi\vartheta :: 5 : 1$.

But we must find the value of $o\sigma$. If from the point c (Fig. 3.) we draw a perpendicular to the axis, it will fall at the extremity a of that axis. For $cf = \frac{1}{4} of$. Therefore, since ca is parallel to fr, the distance ar will be $\frac{1}{4}$ of or. Hence $ar = \frac{1}{3} ao$. From this it follows, that the extremity a of the perpendicular coincides with that of the axis of the nucleus. Since then $c\sigma$ (Fig. 4.) corresponds with ca (Fig. 3.), the point σ (Fig. 4.) is so situated, that $o\sigma$ is the excess of the axis of the metastatic crystal above that of the nucleus. Hence $o\sigma = 3$. Of consequence the proportion $o\sigma : \sigma\lambda :: 5 : 1$ becomes $3 : \sigma\lambda :: 5 : 1$. So that $\sigma\lambda = \frac{3}{5}$.

To obtain a value for $c\sigma$ or its equal ac (Fig. 3.) we have this proportion, $or : fr :: ao : ac$; or $4 : 2 :: 3 : ac = \frac{3}{2} = c\sigma$. Therefore the equation $c\lambda = c\sigma - \sigma\lambda$ becomes $c\lambda = \frac{3}{2} - \frac{3}{5} = \frac{9}{10}$.

We have still to find the value of $\lambda\tau$. The triangles $c\tau\zeta$ and $c\sigma\mu$ give $c\tau : \tau\zeta :: c\sigma : \sigma\mu$; or $c\lambda + \lambda\tau : \tau\zeta :: c\sigma : \sigma\mu$. But $\tau\zeta = 5\lambda\tau$; because these quantities are proportional to $o\sigma = 3$ and $\sigma\lambda = \frac{3}{5}$.

Calling g' and p' the two demidiagonals of the equiaxe, we have $c\sigma : \sigma\mu :: \sqrt{\frac{1}{3} g'^2} : \frac{1}{3}\sqrt{9p'^2 - 3g'^2} :: \sqrt{\frac{1}{3} . 12} : \frac{1}{3}\sqrt{9 . 5 - 3 . 12} :: \sqrt{4} : \sqrt{1} :: 2 : 1$. We have seen already, that $c\lambda = \frac{9}{10}$. Therefore the proportion $c\lambda + \lambda\tau : \tau\zeta :: c\sigma : \sigma\mu$ becomes $\frac{9}{10} + \lambda\tau : 5\lambda\tau :: 2 : 1$. This gives us $\lambda\tau = \frac{1}{10}$.

If we now substitute for $c\lambda$ and $\lambda\tau$ their values thus found in the equation $c\tau = c\lambda + \lambda\tau$, we obtain $c\tau = \frac{9}{10} + \frac{1}{10} = 1$.

2. For $\tau\sigma$. $\tau\sigma = c\sigma - c\lambda - \lambda\tau = \frac{3}{2} - \frac{9}{10} - \frac{1}{10} = \frac{5}{10} = \frac{1}{2}$.

Therefore $c\tau = 2\tau\sigma$. Therefore likewise $c\zeta = 2\zeta\mu$; which was the thing to be proved. Now, since $\zeta\mu$ (Fig. 2.) $: \gamma\zeta :: \sqrt{5} : \sqrt{12}$, we have $c\zeta : \gamma\zeta :: \sqrt{20} : \sqrt{12} :: \sqrt{5} : \sqrt{3}$; which is exactly the ratio of the two demidiagonals of the inverse rhomboid. Hence, of the two triangles $\varepsilon\mu\gamma$, $\varepsilon c\gamma$, the one belongs to the equiaxe, and the other to the inverse variety; and the two heights $c\zeta$, $\mu\zeta$ of these triangles have to each other the same ratio as the heights ch, ih of the triangles which compose the trapezoid $i\gamma$, cz.

Let us now go to the trapezoid $c\gamma pr$, and find, in the first place, expressions for the three sides of the triangle $c\gamma r$.

1. For $c\gamma$. $c\gamma = \sqrt{(c\zeta)^2 + (\gamma\zeta)^2}$ and $c\zeta$ (Fig. 4.) $= \sqrt{(c\tau)^2 + (\tau\zeta)^2} = \sqrt{(c\tau)^2 + (5\lambda\tau)^2} = \sqrt{1 + \frac{25}{100}} = \sqrt{1 + \frac{1}{4}} = \sqrt{\frac{5}{4}}$. Farther, $\gamma\zeta$ (Fig. 2.) $: c\zeta :: \sqrt{3} : \sqrt{5}$. Or $\gamma\zeta : \sqrt{\frac{5}{4}} :: \sqrt{3} : \sqrt{5}$. Of consequence $\gamma\zeta = \sqrt{\frac{3}{4}}$ and $c\gamma = \sqrt{\frac{5}{4} + \frac{3}{4}} = \sqrt{2}$.

2. For cr. $cr = \sqrt{(ch)^2 + (hr)^2} = \sqrt{\frac{9}{4} + \frac{3}{4}} = \sqrt{3}$.

3. For γr. If we conceive a plane perpendicular to the axis to pass through the line $\gamma\varepsilon$, it will cut the axis at a point ν (Fig. 4.) Let us determine the value of $o\nu$. We have $o\nu = o\sigma - \sigma\nu = o\sigma - \tau\zeta = o\sigma - 5\lambda\tau = 3 - \frac{5}{10} = \frac{5}{2}$. But the axis $ou = 9 = \frac{18}{2}$. Therefore the point γ (Fig. 2.) which is at the height of the point ν (Fig. 4.) is situated opposite the $\frac{5}{18}$ of the axis. But the point d (Fig. 2. and 3.) is situated opposite the $\frac{5}{9}$ of the axis, since $og = 5$. Hence it follows, that the point γ (Fig. 2.) is in the middle of the line od. But the point r is in the middle of the line df. Therefore $\gamma r = \frac{1}{2} of = \frac{1}{2}\sqrt{(or)^2 + (fr)^2}$ (Fig. 3.) $= \frac{1}{2}\sqrt{16 + 4} = \sqrt{5}$.

Thus we have found $c\gamma = \sqrt{2}$; $cr = \sqrt{3}$; and $\gamma r = \sqrt{5}$. Hence we are entitled to conclude, 1. That the angle γcr is a right angle; 2. That the triangle $c\gamma r$ is similar and equal to the fourth part of one of the faces of the nucleus divided by the two diagonals.

Having obtained the angle $\gamma cr = 90°$, let us find the angles γpr and $c\gamma p$.

1. For the angle γpr. This angle is the supplement of dpr. But in the triangle rpd, we know $dr = \frac{1}{2} df = \frac{1}{2}\sqrt{5}$. We know $pr = ir = \sqrt{(rh)^2 + (ih)^2} = \sqrt{\frac{3}{4} + \frac{9}{16}} = \frac{1}{4}\sqrt{21}$. Hence $dr : pr :: \sqrt{20} : \sqrt{21}$. The angle pdr, which belongs to one of the faces of the metastatic crystal, is supposed known. Its value is 54° 27′ 30″. From these data we obtain $dpr =$ 52° 34′ 7″. Hence it follows, that $\gamma pr =$ 127° 25′ 53″.

2. For the angle $c\gamma p$. That angle is composed of the two angles $c\gamma r$, $p\gamma r$, the first of which is half the obtuse angle of the primitive rhomb, that is to say, it is equal to 50° 46′ 6″. Now, as $\gamma pr =$ 127° 25′ 53″; as $pr = \frac{1}{4}\sqrt{21}$ and $\gamma r = \sqrt{5}$, it is easy to discover, that $p\gamma r =$ 24° 0′ 24″. Adding this value to that of $c\gamma r$, we obtain $c\gamma p =$ 74° 46′ 30″.

The fourth angle crp must, of course, be equal to 67° 47′ 37″.

We have still to determine the incidence of $c\gamma pr$ upon $czir$, and that of $c\gamma\mu\varepsilon$ on $c\gamma pr$.

Plate CCXXV. Fig. 5.

1. For the incidence of $c\gamma pr$ on $czir$. Let rcz (Fig. 5.) be the same triangle as in Fig. 2. Draw cn (Fig. 5.) situated as cf (Fig. 2.), and produced in such a manner that the lines rn, zn, drawn to its extremity, are perpendicular to it. Draw likewise ch, the height of the triangle rcz, and nh and ng perpendicular to cr, na perpendicular to ch, and lastly ag. The angle nga, which measures the incidence of ncr or crz, is the supplement of that which measures the mutual inclination of the planes $criz$, $c\gamma pr$ (Fig. 2.) Hence the problem is reduced to find the angle nga (Fig. 5.) Let us find, in succession, the value of ng and na.

(1.) For na. On account of the right-angled triangle cnh, $na = \frac{cn \times pn}{ch}$.

$ch = \sqrt{\frac{9}{4}}$; and $rh : hn :: \sqrt{5} : \sqrt{3}$, because the angle rnz measures the smallest inclination of the faces of the metastatic crystal. But $rh = \sqrt{\frac{3}{4}}$, therefore $hn = \sqrt{\frac{3}{4}\cdot\frac{3}{5}} = \sqrt{\frac{9}{20}}$. And $cn = \sqrt{(ch)^2 - (hn)^2} = \sqrt{\frac{9}{4} - \frac{9}{20}} = \sqrt{\frac{9}{5}}$. Hence $na = \frac{\sqrt{\frac{9}{5}} \times \sqrt{\frac{9}{20}}}{\sqrt{\frac{9}{4}}} = \sqrt{\frac{9}{25}}$.

(2.) For ng. $ng = \frac{cn \times nr}{cr}$.

Now we already know that $cn = \sqrt{\frac{9}{5}}$; $nr = \sqrt{(rh)^2 + (hn)^2} = \sqrt{\frac{3}{4} + \frac{9}{20}} = \sqrt{\frac{6}{5}}$; and $cr = \sqrt{(ch)^2 + (rh)^2} = \sqrt{\frac{9}{4} + \frac{3}{4}} = \sqrt{3}$. Hence $ng = \frac{\sqrt{\frac{9}{5}} \times \sqrt{\frac{6}{5}}}{\sqrt{3}} = \sqrt{\frac{18}{25}}$.

Therefore $ng : na :: \sqrt{18} : \sqrt{9} :: \sqrt{2} : \sqrt{1}$. Hence it follows, that $nga = 45°$. Of consequence, the inclination of $c\gamma pr$ to $czir$ is 135°.

Fig. 6.

2. For the incidence $c\gamma\mu\varepsilon$ (Fig. 2.) $c\gamma pr$. Let $\gamma c\varepsilon$ (Fig. 6.) be the same triangle as in Fig. 2. Draw $c\nu$ (Fig. 5.) situated as co (Fig. 6.) and of such a length that the straight lines $\gamma\nu$, $\varepsilon\nu$ (Fig. 6.) drawn to its extremity, are perpendicular to it. Draw likewise $\nu\zeta$ perpendicular to $\gamma\varepsilon$, $\nu\lambda$ perpendicular to $c\zeta$, $\nu\pi$ perpendi-

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cular to $c\zeta$; lastly, draw $\lambda\pi$. The angle $\nu\lambda\pi$ will be the supplement of that which measures the inclination wanted. Let us find $\nu\lambda$ and $\nu\pi$.

PLATE CCXXV. Fig. 6.

(1.) For $\nu\lambda$; $\nu\lambda = \frac{c\nu \times \gamma\nu}{c\gamma}$.

We have already found $c\gamma = \sqrt{2}$. And $c\nu = \sqrt{(c\zeta)^2 + (\zeta\nu)^2}$ and we have found, $c\zeta = \sqrt{\frac{5}{4}}$. Farther, $\gamma\zeta = \sqrt{\frac{3}{4}}$. But $\gamma\zeta : \zeta\nu :: \sqrt{5} : \sqrt{3}$. Hence $\zeta\nu = \sqrt{\frac{9}{20}}$. Therefore $c\nu = \sqrt{\frac{3}{4} + \frac{9}{20}} = \sqrt{\frac{16}{20}} = \sqrt{\frac{4}{5}}$.

$$\gamma\nu = \sqrt{(\gamma\zeta)^2 + (\zeta\nu)^2} = \sqrt{\tfrac{3}{4} + \tfrac{9}{20}} = \sqrt{\tfrac{6}{5}}. \text{ Hence}$$

$$\nu\lambda = \frac{\sqrt{\frac{4}{5} \times \frac{6}{5}}}{\sqrt{2}} = \sqrt{\tfrac{12}{25}}.$$

(2.) For $\nu\pi$; $\nu\pi = \frac{c\nu \times \zeta\nu}{c\zeta}$. And $c\nu = \sqrt{\frac{4}{5}}$; $\zeta\nu = \sqrt{\frac{9}{20}}$; and $c\zeta = \sqrt{\frac{5}{4}}$. Therefore $\nu\pi = \frac{\sqrt{\frac{4}{5} \times \frac{9}{20}}}{\sqrt{\frac{5}{4}}} = \sqrt{\frac{36}{25\ 5}}$.

Hence $\nu\lambda : \nu\pi :: \sqrt{\frac{12}{25}} : \sqrt{\frac{36}{25\ 5}} :: \sqrt{5} : \sqrt{3}$.

Now this is the ratio between the side of the primitive rhomb and half the horizontal diagonal Consequently the angle $\nu\lambda\pi = \frac{101^\circ\ 32'\ 13''}{2} = 50^\circ\ 46'\ 6''$.

Fig. 2. Hence it follows that the incidence of $c\gamma\mu\varepsilon$ (Fig. 2.) on $c\gamma pr$, is $129^\circ\ 13'\ 54''$.

Of the Primitive Forms different from the Parallelopiped.

Primitive forms different from the parallelopiped.

When the primitive form is a cube, the investigation of the secondary crystals admits of certain modifications, which in some cases considerably shorten the calculus. But as there is no new principle in these investigations different from what has been already explained while treating of the rhomboid; we do not consider it as necessary to introduce the peculiar methods here. Those readers who are interested in the subject, will find it amply discussed in Hauy's *Mineralogie*, vol. i. p. 410.

All the other primitive forms, namely, the rhomboidal dodecahedron, the tetrahedron, the octahedron, the six-sided prism, and the bipyramidal dodecahedron, may, by very simple analogies, be brought under the case of parallelopipeds. Indeed we may, without injuring the theory, substitute instead of them a parallelopipedal nucleus, and refer all the decrements to it. The most difficult to manage in that way is the bipyramidal dodecahedron; but it so very seldom occurs in the mineral kingdom as a primitive form, that we do not think it necessary to enter upon the subject here. We again refer the reader to Hauy (*Mineralogie*, vol. i. p. 451.) for all the elucidations necessary to beginners.

Method of determining the ratio between the principal dimensions of the integrant molecules.

On the ratio between the principal dimensions of the integrant molecules.

This is an element in all the calculations respecting secondary crystals; of course, the consideration of it cannot be omitted. Some forms furnish us at once with these ratios, in consequence of the perfect regularity which they appear to possess. For example, we cannot doubt that the form of the integrant molecule of common salt is a cube, and that the primitive crystal of blende is a dodecahedron, with rhomboidal faces equal

and similar; from which it follows, that the integrant molecules are tetrahedrons, having equal and similar triangular faces. From this it follows, that the ratio between the two diagonals of each rhomb is that of $\sqrt{2}$ to 1.

But in certain cases (as when the primitive form is a rhomboid) there is nothing which indicates the size of the angles. In such cases, peculiar methods must be employed to obtain the requisite ratios. Hauy, to whom we are indebted for every thing relating to this subject, has been guided in his investigations by this maxim, that *two quantities are to be considered as equal, when observation points out no difference between them.*

To give an example: When the regular hexahedral prism of carbonate of lime is mechanically divided, we observe, that each section has the same inclination both to the base and to the adjacent face of the prism. If we suppose that this holds rigorously, it is easy to see, that in the rhomboid of calcareous spar, the triangle acn (Fig. 7.), formed by the oblique demi-diagonal ac, by the demi-pendicular cn on the axis, and by an, the third of the axis, is at the same time rectangular and isosceles. Hence it follows, that $cn = an$, or $\sqrt{\frac{1}{3}g^2} = \frac{1}{3}\sqrt{9p^2 - g^2}$. Taking away the radicals, getting rid of the denominators, and simplifying, the equation becomes $g^2 = 3p^2 - g^2$. Hence $2g^2 = 3p^2$ and $g : p :: \sqrt{3} : \sqrt{2}$. PLATE CCXXIV. Fig. 7.

As a second example, we shall make choice of the tourmaline. Crystals of this mineral are known, which have the form represented in Fig. 7. When we measure the inclination of o to l, we find it sensibly the same as that of the edge x to the face P′. But the lateral edges y, y' of the faces o being parallel to each other, and to the oblique diagonal of the primitive face P, it is evident, from simple inspection, that these faces result from the decrement ${}^1E^1$ (Fig. 8.) We see, likewise, that the faces l (Fig. 7.) are produced by a decrement $\overset{2}{e}$. PLATE CCXXV. Fig. 7. Fig. 8.

Let $gads$ (Fig. 18.) be the section of the nucleus of the tourmaline, and tg a line situated as the apotheme of the triangle o (Fig. 7, Plate CCXXV.) It follows, from what has just been stated, that the inclination of o to l is equal to that of tg (Fig. 18.) to a line drawn through the point g parallel to the axis. Or, which is the same thing, it is the supplement of the angle gtn, on the hypothesis that gt is the oblique angle of a rhomboid resulting from the law ${}^1E^1$. Again, the angle formed by x with P′ (Fig. 7.) is equal to the angle gad (Fig. 18.); or, which comes to the same thing, it is the supplement of the angle ags. Hence $gtn = ags$. Therefore $gn : tn ::$ Sin. ags : Cos. ags. Substituting the algebraic values, we get $\sqrt{\frac{4}{3}g^2} : \frac{2n+3}{6n}\sqrt{9p^2 - 3g^2} :: \sqrt{3g^2p^2 - g^4} : g^2 - p^2$. Getting rid of the denominators, and dividing the two first terms by 2, the proportion becomes $\sqrt{g^2} : 2\sqrt{3p^2 - g^2} :: \sqrt{3p^2g^2 - g^4} : g^2 - p^2$. Dividing the two antecedents by g, and multiplying the extremes and means, we get $2(3p^2 - g^2) = g^2 - p^2$. Therefore $7p^2 = 3g^2$, and $g : p :: \sqrt{7} : \sqrt{3}$. PLATE CCXXIV. Fig. 18.

When such analogies are wanting, Hauy arrives at the ratio of the dimensions by adopting the simplest ratio which agrees with the measurement of the inclinations of the faces, and considering it as exact. An example will make the method obvious. Let us make choice of sulphate of iron, the primitive form of which is an acute rhomboid. By the goniometer we find that the smallest inclination of the faces of this rhomboid is nearly $81^\circ\ 30'$. If the ratio between the cosine of this

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angle and radius could be expressed in rational numbers, we would have a simple ratio between g and p. But the logarithm of the sine of 81° 30′ is 9,1697021, which gives for the sine 14781, a number very near 15000. But radius being 100000, we see that the ratio of 15 to 100, or 3 to 20, may be taken without sensible error for the true one. We have then $2p^2 : p^2 - g^2 :: 20 : 3$, or $6p^2 = 20p^2 - 20g^2$, and $10g^2 = 7p^2$. This gives us $g : p :: \sqrt{7} : \sqrt{10}$. According to this hypothesis, the smallest inclination of the faces of the rhomboid is 81° 23′, a quantity which differs only by 7′ from observation. Hence the ratio $\sqrt{7} : \sqrt{10}$ is adopted as the true one.

When all these methods fail, which is often the case, the method adopted by Hauy is this. He supposes the secondary crystals formed by a simple decrement; and from this decrement, and the form of the secondary crystal, the dimensions of the integrant molecules are inferred. We shall not give an example of this method; abundance will be found in the writings of Hauy.

We cannot avoid observing, that this is the weak part of the Hauyan theory. Now that we are in possession of accurate goniometers, it may be greatly improved, and the calculus considerably facilitated. What Hauy has been able to effect, considering the imperfect instruments in his possession, is really surprizing, and does infinite honour both to his industry and sagacity. But it is extremely probable that he is wrong in the dimensions of a great many of the integrant molecules, and of course that the form of the primitive crystal which he assigns, is not perfectly correct. It would be easy to give examples of this supposed inaccuracy; but the task would be invidious. Hauy is at present engaged in printing a new edition of his work; and, as he is now in possession of much better instruments, we may expect considerable ameliorations and improvements.

Chap. III.

Of the Crystalline Forms hitherto observed in the Mineral Kingdom.

Crystalline forms in the mineral kingdom.

This part of our task is attended with considerable difficulty. The different crystals hitherto observed, are too numerous to put it in our power to give figures of the whole, and we are afraid that bare description without figures will scarcely be understood. We shall adopt a middle course. We shall describe particularly only those crystals belonging to each species which we consider as of most importance; and we shall give figures of those only which the young mineralogist ought to make himself familiar with, before he undertakes the general investigation of crystals.

The number of crystals figured by Hauy in his Mineralogy, amounts to about 564. But there would be no difficulty in more than doubling that number. Bournon has figured no fewer than 642 crystals of carbonate of lime; but a considerable number of these are merely simple modifications of the same crystalline form. Hauy has announced, that he will give, in his new edition, the figure of 150 varieties of carbonate of lime. From this statement, the reader will perceive the great extent of the subject, and the consequent difficulties under which we must labour. We shall not think it necessary to notice every species of mineral, but only the most important.

We shall arrange our observations according to the primitive forms of the crystals, beginning with the parallelopiped, which is the most important.

I. Crystals whose primitive Form is the Parallelopiped.

Parallelopiped.

These may conveniently be arranged under ten distinct groups, according to the particular shape of the parallelopiped.

I. *Primitive form a Cube.*

Cube.

To this belong twelve species of minerals; namely,

1. *Common salt.* This species, as far as we have seen it, exists only in three regular forms; 1. The cube; 2. The regular octahedron, formed by a decrement of one range upon each angle; 3. The cubo-octahedron, which is a cube with each of its angles wanting, and a triangular face in their place. It is obviously the second form not completed. Common salt.

2. *Borate of magnesia, or boracite.* Two varieties of the crystals of this species have been observed. 1. A cube with all its edges and four of its angles truncated. This is produced by a decrement of one range upon all the edges, and upon the alternate angles. 2. The same figure as the preceding, with this addition, that the angles left untouched in the first variety, have in this no fewer than four small facets in their place. This is produced by a farther decrement of two ranges upon the alternate angles. Boracite.

3. *Leucite, or amphigene.* This mineral occurs usually in lavas, and, as far as we have seen, is always crystallized in a form nearly spheroidal, having 24 trapezoidal faces. Some notion may be formed of it from inspecting Fig. 9. Leucite. Plate CCXXV. Fig. 9.

4. *Analcime, or cubizite.* This mineral is common in greenstone, and occurs in Salisbury Craigs. We have only seen it crystallized in two forms; 1. A cube, with each angle replaced by three facets. 2. A twenty-four sided figure, bounded by trapezoidal faces, equal and similar. This figure is represented in Fig. 10. It is produced by a decrement of two ranges upon all the angles of the cubic nucleus. The first variety is produced by the same decrement, stopped short before it had completed the trapezoidal faces. Analcime. Fig. 10.

5. *Aplome.* This is a mineral usually crystallized in the rhomboidal dodecahedron. The figure of the garnet is easily distinguished by its inferior specific gravity and lustre. The figure is produced by a decrement of one range on all the edges of the cubic nucleus. Aplome.

6. *Galena, or sulphuret of lead.* The usual figure of this species is the cube; sometimes the octahedron; frequently the cubo-octahedron. The edges and angles of the octahedron are sometimes variously truncated. Galena.

7. *Pyrites, or sulphuret of iron.* Of this there are three species; but one of them, *magnetic pyrites*, may be omitted here. It occurs sometimes in cubes, but is usually amorphous. Hence its crystalline forms are still almost unknown. The other two species are, the *common* pyrites, and the *radiated* pyrites. The first has a cube for its primitive form, the second a right quadrangular prism with a rhombic base, for its primitive form. Hence it belongs to a subsequent group. Pyrites occurs under such a variety of forms, that it would be quite impossible to describe them all here. The two species were long confounded, which occasioned considerable confusion. Bournon pointed out, long ago, the necessity of distinguishing different crys- Pyrites.

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tals of pyrites from each other; and Hauy has lately constituted two species. The first, called *sulphuret of iron*, has a cube for its primitive form. The second, called *white sulphuret of iron*, has a rhomboidal prism for its primitive form, and includes under it all the octahedral crystals of pyrites. If reliance can be put upon the analysis of Hatchett, the composition of these two sulphurets is the same. They therefore constitute an anomaly in the theory of crystallization, similar to that already known in the difference between arragonite and calcareous spar.

Glance cobalt ore.

8. *Glance cobalt ore.* This ore, which occurs in Sweden, is usually crystallized in cubes, or figures derived from it.

Phosphate of manganese-and-iron.

9. *Phosphate of manganese-and-iron,* or pitchy iron ore.

Native gold, silver, and copper.

10, 11, 12. *Native gold, silver, and copper.*

II. *Right quadrangular Prism, base a Square.*

Right quadrangular prism with a square base.

This primitive form, which may be considered as a lengthened cube, belongs to eight species of minerals, namely,

Sulphate of magnesia.

1. *Sulphate of magnesia.* It crystallizes in rectangular prisms, the bases of which are squares. This form is by no means uncommon, though it is more usual to observe the prism terminated by four-sided pyramids, as is represented in Fig. 11.

Plate CCXXV. Fig. 11.

Vesuvian.

2. *Vesuvian or Idocrase.* The primitive form of this substance was at first supposed a cube; but Hauy afterwards determined the real form. It occurs usually in six-sided prisms, terminated by five-sided figures, as represented in Fig. 12. The narrow vertical faces *d*, are produced by a decrement of one range on the vertical edges of the nucleus; the 4 six-sided terminal faces *c, c, c*, by a decrement of two ranges on the angles of the base. The small face P is the remains of the base.

Fig. 12.

Meionite.

3. *Meionite.* This mineral, like the last, occurs in the lava of Mount Vesuvius. The crystals are very small, and are usually eight or twelve sided prisms. The most common variety is represented in Fig. 13.

Fig. 13.

Mesotype.

4. *Mesotype, or radiated zeolite.* This is the mineral originally called *zeolite* by Cronstedt, a name which ought still to be preserved. The most common varieties of its crystals are represented in Fig. 14. and 15.

Figs. 14, 15.

Paranthine and wernerite.

5. *Paranthine or scapolite, and wernerite.* These two minerals seem to belong to the same species. They have been found in Sweden and Norway; and about five different kinds of crystals have been described.

Chromate of lead.

6. *Chromate of lead.* It usually occurs in four-sided prisms, terminated by four-sided pyramids.

Uranmica.

7. *Uranmica,* or green oxide of uranium.

Ruthile.

8. *Ruthile,* or oxide of titanium.

III. *Right quadrangular Prism, with a rectangular Base.*

Right quadrangular prism, with a rectangular base.

This primitive form, like the last, belongs to eight species of minerals.

Cryolite.

1. *Cryolite.* This triple salt is composed of fluoric acid, soda, and alumina, and has been hitherto observed only in Greenland. As far as we know, no regular crystals have yet been observed; but the mineral is foliated, and yields the primitive form by mechanical division.

Anhydrous sulphate of lime.

2. *Anhydrous sulphate of lime.* The crystals of this curious species hitherto observed, have been described by Bournon in the *Jour. de Min.* tom. xiii. p. 346. To this description we refer the reader.

Chrysoberyl.

3. *Chrysoberyl or cymophane.* The most common crystal of this species is represented in Fig. 16. Some new varieties have been described by Hauy in the *Annales du Mus. d'Hist. Natur.* vol. xviii. p. 57.

Plate CCXXV. Fig. 16.

Chrysolite.

4. *Chrysolite or peridot.* The most common crystals of this species are represented in Fig. 17. and 18.

Figs. 17, 18.

Stilbite.

5. *Stilbite, or foliated zeolite.* The crystals of this mineral are usually long, and very beautiful. Fig. 19. represents the variety that perhaps occurs most frequently.

Fig. 19.

Apophyllite.

6. *Apophyllite or ichthyophthalmite.* The crystals belonging to this mineral will be found described by Hauy in the *Jour. de Min.* vol. xxiii. p. 385. One of the crystals described in his mineralogy as belonging to the Stilbite, belongs in fact to this species.

Prehnite.

7. *Prehnite.* This mineral, when it is crystallized, usually assumes the figure of a thin rhomboid, similar to Fig 20.

Fig. 20.

Wolfram.

8. *Wolfram.* The primitive crystal of this species sometimes occurs; but a more common variety is represented in Fig. 21. The faces marked P, M, T, are those of the primitive crystal; the faces *s, s*, are produced by the decrement $A\frac{1}{2}\ \frac{1}{2}A$.

Fig. 21.

IV. *Right quadrangular Prism, Base a Rhomb.*

Right quadrangular prism, base a rhomb.

This primitive form is equally prolific with any of the preceding, belonging to no fewer than twelve species; namely,

Sulphate of barytes.

1. *Sulphate of barytes.* This species, next to calcareous spar, is the most prolific in varieties of crystalline forms. Hauy has announced, that he intends to describe no fewer than 60 of these in the new edition of his Mineralogy. The primitive form occasionally occurs in very small crystals, but by far the most common form, at least in this country, is what Hauy calls the *trapezienne*, represented in Fig. 22. The symbol for which is $\underset{d}{\overset{2}{\mathrm{A}}}\ \underset{o}{\overset{1}{\mathrm{E}}}\ \underset{\mathrm{P}}{\mathrm{P}}$, which will be understood from the letters on the figure.

Fig. 22.

Sulphate of strontian.

2. *Sulphate of strontian.* A considerable number of varieties of these crystals have been observed, almost all in Sicily. We have never seen it assume the primitive form. A common variety is the *unitaire* of Hauy, a kind of wedge-shaped octahedron, represented in Fig. 23; the symbol for which is $\underset{\mathrm{M}}{\mathrm{M}}\ \underset{o}{\overset{1}{\mathrm{E}}}$.

Fig. 23.

Datholite.

3. *Datholite,* or *siliceous borate of lime.* This scarce species has been hitherto found only at Arendal in Norway. The base of its primitive form is a rhomb, with angles of 109° 28′ and 70° 32′; and the height of the prism is to a side of the base as 16 to 15. Only one variety of its crystals has hitherto been described, a kind of ten-sided prism. See *Jour. de Mines*, vol. 19, p. 362.

Granatite.

4. *Granatite* or *staurotide.* It occurs usually in the form of two six-sided prisms crossing each other at right angles, as represented in Fig. 24.

Fig. 24.

Diaspore.

5. *Diaspore.* This singular mineral is a compound of alumina and water; and in this respect agrees with Wavellite. It has not hitherto been found crystallized.

Hyperstene.

6. *Hyperstene* or *labradore hornblende.* This mineral has been lately separated from hornblende, and constituted a species apart by Hauy. It comes from Labradore, and, as far as we know, has not hitherto been observed crystallized.

Mica.

7. *Mica.* The primitive form of this mineral is a prism, with rhomboidal bases, the angles of which are 120° and 60°. It usually occurs crystallized in plates,

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similar to that represented in Fig. 25. The symbol for which is $M\,{}^1H^1\,T\,P$.
$M\ r\ T\ P$

Plate CCXXV. Fig. 25. Talc.

8. *Talc.* The primitive form of this species, and the crystalline forms which it assumes, are exactly the same with those of mica; yet it is necessary to consider them as distinct species, because their composition and external characters differ.

Spodumene.

9. *Spodumene* or *triphane.* This mineral occurs in the mine of Uto in Sweden, and has not hitherto, as far as we know, been observed in crystals.

White-iron pyrites.

10. *White-iron pyrites.* We noticed this species before when speaking of common cubic pyrites.

Arsenical pyrites. Plate CCXXV. Fig. 26.

11. *Arsenical pyrites, or mispickel. Arsenical iron* of Hauy. About six varieties of form of this species are known. One of the most common, (not reckoning the primitive form,) is that represented in Fig. 26, called *ditetrahedre* by Hauy; the symbol for which is $M\,\overset{6}{E}$.
$M\ r$

Molybdena.

12. *Molybdena.* It seldom occurs crystallized. Crystals sometimes occur similar to the crystal of mica, represented in Fig. 25. Schmeifser describes a crystal consisting of a six-sided prism, terminated at both ends by a six-sided pyramid.

Right quadrangular prism, base an oblique parallelogram.

V. *Right quadrangular Prism, Base an oblique Parallelogram.*

This form belongs to three species of minerals. We believe that there is a fourth species ranked by Hauy among prisms with a rectangular base, which really ought to be placed here. The species are:

Gypsum. Fig. 27.

1. *Gypsum*, or *sulphate of lime* The primitive form of this species, is a pretty tall quadrangular prism. The most common variety of its crystals is the *trapezienne* of Hauy, represented in Fig. 27; the symbol for which is $\overset{2}{C}\,\overset{1}{E}\,P$.
$f\ l\ P$

Pistazite. Plate CCXXVI. Figs. 1, 2.

2. *Pistazite*, or *epidote*, and *zoisite.* This is a very common mineral, though it occurs very frequently in an amorphous form. The most common varieties of its crystals which we have been accustomed to see, are represented in Fig. 1, 2. The symbol for the first is $T\,M\,{}^1G^1\,\overset{1}{B}$, the symbol for the second $T\,M\,{}^1G^1\,\overset{1}{C}\,\overset{1}{B}\,\overset{\frac{1}{2}}{E}\,P$.
$T\,M\ r\ z$ $\quad T\,M\ r\ o\ z\ e\ P$

Axinite. Fig. 3.

3. *Axinite*, or *thummerstone.* This mineral is named from the resemblance which its crystals have to the shape of an axe. Though a good many varieties have been described, they all bear a close resemblance to each other. The most common form is represented in Fig. 3. Its symbol is $\overset{2}{C}\,\overset{3}{B}\,\overset{5}{O}\,P$.
$r\ u\ s\ P$

Euclase.

4. We believe that *euclase*, which is described by Hauy as having a rectangular base, has, in fact, an oblique base, and therefore should be placed here. But the mineral is so scarce that it is difficult to examine it.

Oblique quadrangular prism, with a rectangular base.

VI. *Oblique quadrangular Prism, with a rectangular Base.*

Borax.

To this primitive form belongs only one species, namely *borax* or *subborate of soda.* We have never seen any natural specimens of it crystallized with any regularity. But by artificial crystallization it may be obtained under a variety of forms. It usually assumes the form of a six-sided prism.

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Oblique quadrangular prism, base a rhomb.

VII. *Oblique quadrangular Prism, Base a rhomb.*

Glauberite.

To this primitive form belong five species; namely,
1. *Glauberite.* This mineral, hitherto found only in Spain, is composed of nearly equal weights of anhydrous sulphate of lime and anhydrous sulphate of soda. Its base is a rhomb, with angles of 75° 32′ and 104° 28′. Hitherto only one variety of form has been observed. It is an oblique very flat prism, putting one in mind of the common variety of axinite.

Amphibole. Plate CCXXVI. Fig. 4.

2. *Amphibole*, including *hornblende, actinolite, grammatite, tremolite.* This is one of the most abundant mineral species. Hornblende is dark green, almost black; actinolite usually a lighter green; and tremolite almost white. The crystals are usually four or six sided prisms. One of the most common varieties is represented in Fig. 4; the symbol for which is $M\,{}^1G^1\,P\,\overset{\frac{1}{2}}{B}$.
$M\ x\ P\ r$

Augite. Fig. 5.

3. *Augite*, or *pyroxene, coccolite, diopside, salite.* This is also a very common species, occurring abundantly in trap rocks. The crystals are not very numerous in point of variety of form. One of the most common varieties is represented in Fig. 5. The symbol for it is $M\,{}^1H^1\,E^1\,{}^1E$. It is the *bisunitaire* of Hauy.
$M\ r\ \ s$

Gadolinite.

4. *Gadolinite.* Hauy has announced, that the primitive figure of this mineral is an oblique rhomboidal prism. We have never had an opportunity of seeing it crystallized.

Orpiment.

5. *Orpiment*, or *sulphuret of arsenic.* Hauy has lately ascertained, that the primitive form of sulphuret of arsenic, both red and yellow, is the same; namely, an oblique prism with rhomboidal bases, the angles of which are 72° 18′ and 107° 42′. See *Ann. du Mus. d'Hist. Nat.* vol. xvi. p. 19. Hence these two substances, if their composition prove different, will constitute another anomaly in the theory of crystallization.

Oblique quadrangular prism, base an oblique parallelogram.

VIII. *Oblique quadrangular Prism, Base an oblique Parallelogram.*

To this primitive form belong three species of minerals; namely,

Felspar. Fig. 6.

1. *Felspar.* This is perhaps the most abundant mineral in nature. It occurs crystallized in a considerable variety of forms. Perhaps that represented in Fig. 6. is the most useful to be known. Its symbol is $G^2\,T\,P$.
$l\ T\,P$

Cyanite. Fig. 7.

2. *Cyanite*, or *disthene.* This mineral occurs most commonly without any regular crystallization. Four different varieties have been described. One of the most common is represented in Fig. 7.

Sulphate of copper. Fig. 8. Fig. 9.

3. *Sulphate of copper.* A variety of crystalline forms of this salt have been observed; but by far the most common is the primitive form represented in Fig. 8, and the *perihexædre* of Hauy, represented in Fig. 9. Its symbol is $M\,{}^1H^1\,T\,P$.
$M\ n\ T\,P$

Rhomboid with an obtuse summit.

IX. *Rhomboid with an obtuse Summit.*

To this primitive form belong eight species of minerals; namely,

Carbonate of lime.

1. *Carbonate of lime*, or *calcareous spar.* The angle at the summit is 105° 5′. This is the most prolific of all known minerals in the variety of forms. The following are the most common varieties:—1. The *equiaxe*,

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Plate CCXXVI. Fig. 10. Fig. 11. Fig. 12. Fig. 13. Fig. 14.

represented in Fig. 10. Its symbol is $\overset{1}{B}$. 2. The *inverse*, represented in Fig. 11. Its symbol is $E^1\,{}^1E$.

$g \quad f$

3. The *metastatic*, represented in Fig. 12. Its symbol is $\overset{2}{D}$. 4. The *contrasting*, represented in Fig. 13. Its symbol is $\overset{3}{c}$. 5. The regular six sided prism, represented in Fig. 14. Its symbol is $\overset{2}{e}\,A$. The equiaxe,

$r \quad m \quad c\ o$

with a very small prism interposed, is called *dog tooth spar*.

Bitter spar.

2. *Bitter spar*, or *magnesian carbonate of lime*. It was supposed formerly to have the same primitive form as calcareous spar. But Dr Wollaston has discovered, that the angle at the summit is 106° 15′.

Carbonate of iron.

3. *Carbonate of iron*, or *flosferri*. It was supposed to have the same primitive form with calcareous spar; but Dr Wollaston has discovered, that the angle at the summit is 107°.

Quartz.

4. *Quartz*. This is a very abundant mineral. The primitive form is a rhomboid, with angles of 94° 4′ and 85° 56′, and therefore differing but little from a cube. This primitive form is uncommon; but Mr Philips of London has specimens of quartz crystallized in this form. They are small; but very distinct. By far the most common variety of its crystals is that repre-

Fig. 15.

sented in Fig. 15. The symbol for which is $\overset{2}{e}\,P\,\overset{\frac{1}{2}}{e}$.

$r\ P\ z$

The terminating pyramids are usually less regular in the size of the faces than is represented in the Figure.

Tourmaline. Fig. 16.

5. *Tourmaline* or *schorl*. The angle at the summit is 113° 34′ 31″. It usually occurs in nine sided prisms. A common variety is represented in Fig. 16. Its symbol is $\overset{1}{D}\,\overset{2}{E}\,\overset{2.0}{e}\,P\,{}^1E^{1\;0.1}\,e^{1.0}$.

$s\ l\ \ P\ o$

Dioptase.

6. *Dioptase*, or *copper emerald*. This mineral comes from Siberia, and is still scarce. But few crystalline forms of it have been observed.

Chabasie.

7. *Chabasie*, sometimes called *cubic zeolite*. It occurs in trap rocks. The angle at the summit is 93° 30′, so that it does not differ much from a cube.

Red silver ore.

8. *Red silver ore, antimoniated sulphuret of silver*. Hauy at first conceived, that the primitive form of this ore was the rhomboidal dodecahedron. But he afterwards ascertained, that it was a rhomboid. The crystalline forms are pretty numerous. But as the one is easily distinguished by its colour and other properties, we need not give figures here.

Rhomboid with an acute summit.

X. *Rhomboid with an acute Summit.*

To this primitive form belong three species of minerals; namely,

Corundum.

1. *Corundum*. This is the name given by mineralogists to the *sapphyr, oriental ruby, corundum, adamantine spar*, and *emery*, which have been shewn by Bournon to belong all to the same species, and to have the same primitive form.

The best description of its crystals was published by Count Bournon in the *Philosophical Transactions*. It occurs in six sided prisms, and in dodecahedrons formed by two six sided pyramids applied base to base.

Oligiste iron ore.

2. *Oligiste iron ore*, or *glance iron ore*. The primitive form does not differ much from a cube, the angles of the rhombs being 87° and 93°. One of the most common varieties of its crystals is represented in Fig. 17. Its symbol is $P\,E^3\,{}^3E\,A$.

$P\ \ n\ \ \overset{2}{s}$

Plate CCXXVI. Fig. 17. Sulphate of iron.

3. *Sulphate of iron*. The angles of the rhomboidal faces are 79° 50′ and 100° 10′. It occurs as commonly in its primitive form as in any other.

Tetrahedron.

II. Crystals whose Primitive form is the Tetrahedron.

Only two species of minerals belong to this class, and both occur among the copper ores; namely,

Copper pyrites; Grey copper ore.

1. *Copper pyrites*; 2. *Grey copper ore*, or *fahlore* and *graugiltigerz*. These two have the same crystalline forms, namely, modifications of the tetrahedron, and probably ought to constitute but one species. The first consists of copper, iron, and sulphur; the second, of copper, iron, arsenic, and sulphur; while the graugiltigerz is composed of copper, iron, antimony, and sulphur. If the arsenic and antimony were mechanical mixtures, then the constituents of all would be the same.

Hexagonal Prism.

III. Crystals whose Primitive form is a Hexagonal Prism.

This crystalline form belongs to eight species of minerals; namely,

Apatite. Fig. 18.

1. *Apatite* or *phosphate of lime*. It occurs often crystallized in the primitive form which is represented in Fig. 18. Most of the varieties bear so close a resemblance or connection with the primitive form, that they may be easily traced to it with the eye.

Carbonate of strontian.

2. *Carbonate of strontian*. It seldom occurs crystallized. The only crystallized specimens of it that we have seen had the primitive form.

Emerald.

3. *Emerald*. This mineral occurs frequently in the primitive form. Indeed all the crystals of it that we have seen are slight modifications of that form. We suspect some of the varieties figured by Hauy as belonging to the euclase, are emeralds.

Nepheline. Fig. 19.

4. *Nepheline* or *sommite*. It occurs often in the primitive form. A common variety is given in Fig. 19. The symbol for which is $M\,\overset{1}{B}\,P$.

$M\ r\ P$

Pinite.

5. *Pinite* or *micarell*. Has considerable resemblance to mica in appearance. We have only seen it crystallized in the primitive form.

Dipyre.

6. *Dipyre*. Two different varieties of crystals belonging to this species have been announced by Hauy. We have not seen them, and cannot therefore describe them.

Sulphurate of copper.

7. *Sulphurate of copper* or *glance copper ore*. As far as we have seen, the crystals of this species are always primitive.

Cinnabar.

8. *Cinnabar*, or *sulphuret of mercury*. It occurs also usually in the primitive form. Only one other variety is described by Hauy.

The reader will observe, that those species which have the six sided prism for a primitive form, occur usually crystallized in that form. The same observation applies to the cube, the tetrahedron, the rhomboidal dodecahedron, and the regular octahedron. But it does not apply to the other primitive forms.

Rhomboidal Dodecahedron.

IV. Crystals whose Primitive form is the Rhomboidal Dodecahedron.

This primitive form belongs only to two species of minerals. The inclination of the faces to each other is obviously 120°.

Crystalline Forms.

Garnet. Plate CCXXVI. Fig. 20.

1. *Garnet.* This species occurs most commonly in the primitive form. We have seen it likewise crystallized, as in Fig. 20. The symbol for which is $\underset{n}{\underset{1}{\overset{r}{B}}}$.

Blende.

2. *Blende.* It occurs crystallized in its primitive form. Likewise in tetrahedrons and octahedrons. And in some other forms which are modifications of these.

Bipyramidal Dodecahedron.

V. Crystals whose Primitive Form is the Bipyramidal Dodecahedron.

Only two mineral species have this primitive form, and they are both salts; namely,

Carbonate of barytes.

1. *Carbonate of barytes.* The crystals of this species are small and rare. Hence its primitive form remained long indetermined. It was first supposed by Hauy to be a six-sided prism. We have seen it crystallized in the primitive form in Scotland. The specimen, we believe, was found at Wanlock-head, but we are not certain.

Phosphate of lead.

2. *Phosphate of lead.* We have seen specimens of the primitive form of this mineral from Cornwall. But it is more commonly crystallized in six-sided prisms.

Octahedron.

VI. Crystals whose Primitive Form is the Octahedron.

This primitive form, next to the parallelopiped, is the most extensive in the mineral kingdom. The crystals belonging to it may be conveniently distributed into four groups, according to the shape of the octahedron.

Regular octahedron.

I. *Regular Octahedron.*

This primitive form belongs to eleven species of minerals; namely,

Salammoniac.

1. *Salammoniac.* This mineral, as far as we know, has never been observed crystallized in a native state. But by artificial crystallization, it has been obtained in regular octahedrons, in cubes, and in a figure bounded by twenty-four trapezoids, somewhat like the leucite crystal.

Fluor spar.

2. *Fluate of lime, Fluor spar.* This mineral occurs usually crystallized in cubes; though we have seen specimens of it crystallized in the primitive form.

Alum.

3. *Alum.* This salt almost always occurs in octahedrons. Sometimes it takes the cubic form, but very rarely. The cubo-octahedron also sometimes occurs.

Spinell.

4. *Spinell,* including *Ceylanite* and *Automalite.* This mineral likewise almost always has the primitive form. Sometimes the edges are truncated in consequence of a decrement of one range parallel to the edges.

Diamond.

5. *Diamond.* This mineral assumes a considerable number of crystalline forms; we have seen at least 30; but no description of them has yet been published. It occurs often in octahedrons, and often likewise with 48 spherical faces, as represented in Fig. 21.

Fig. 21. Native amalgam.

6. *Native amalgam.* This rare mineral occurs usually in regular octahedrons It is said that it has been observed likewise crystallized in rhomboidal dodecahedrons.

Red copper ore.

7. *Red copper ore,* or *Protoxide of copper.* It is most commonly crystallized in octahedrons, sometimes in cubes, sometimes in cubo-octahedrons.

Magnetic iron ore.

8. *Magnetic iron ore,* or *Deutoxide of iron.* The crystals of this mineral are usually octahedrons; sometimes it occurs in rhomboidal dodecahedrons.

White oxide of arsenic.

9. *White oxide of arsenic.* The only crystals of this mineral hitherto observed, are regular octahedrons.

Native bismuth.

10. *Native bismuth.* Hauy has ascertained, by mechanical division, that the regular octahedron is the primitive form of this species. It has been observed in regular crystals of three forms: 1. Regular octahedron. 2. Cube. 3. Rhomboid, with angles of 60° and 120°. See Hauy, *Ann. du Mus. d'Hist. Naturelle,* tom. xii. p. 198.

Native antimony.

11. *Native antimony.* We have seen specimens of this mineral from the mine of Salu in Sweden. But it is very scarce. We do not know that it has ever been observed crystallized. But Hauy has ascertained its primitive form by mechanical division.

Pyramids having a rectangular base.

II. *Pyramids having a rectangular Base.*

This primitive form belongs to 12 species of minerals; namely,

Nitrate of potash.

1. *Nitrate of potash.* This salt sometimes occurs crystallized in its primitive form, but much more commonly in six-sided prisms, often terminated by six-sided pyramids.

Sulphate of soda.

2. *Sulphate of soda.* This salt occurs crystallized in a good many forms. Romé de Lisle gives the fullest and best account of its crystals that we have seen. The common crystals are in four or six-sided prisms, and so much channelled and irregular, that it is scarcely possible to determine their angles.

Lomonite.

3. *Lomonite.* But few crystallized specimens of this mineral have been hitherto observed. Hauy has determined its primitive form, and described some of its varieties in his *Tableau Comparatif,* p. 49, and 195, to which we refer the reader.

Chiastolite.

4. *Chiastolite,* or *Hollowspar*; *Macle* of Hauy. Werner considers this mineral as a sub-species of felspar. But Hauy has ascertained that its primitive form is the octahedron. It occurs usually in four-sided prisms.

Arragonite.

5. *Arragonite.* This species has long puzzled the Abbé Hauy. Its constituents are the same as those of calcareous spar, but its properties are different. He has at last put it into his system as a peculiar species. The fullest description of its crystals is given by Bournon in his *Mineralogie,* to which we refer.

Topaz.

6. *Topaz.* Hauy at first conceived the primitive form of the topaz to be a parallelopiped, consisting of a right prism, with rhomboidal bases. But he afterwards ascertained that it is an octahedron, and the same with that of *shorlous beryl,* to which he has in consequence united it. It occurs most frequently in eight-sided prisms, similar to Fig. 22.

Plate CCXXVI. Fig. 22. Yenite.

7. *Yenite.* This very scarce mineral has been hitherto found only in the Isle of Elba. Hauy, in his *Tableau Comparatif,* has announced the octahedron as its primitive form; and Cordier, the discoverer of the mineral, has described five varieties of crystal in the *Jour. des Min.* vol. xxi. p. 65.

Carbonate of lead.

8. *Carbonate of lead.* This mineral occurs crystal lized in octahedrons, and likewise in bipyramidal dodecahedrons, and six-sided prisms.

Sulphate of lead.

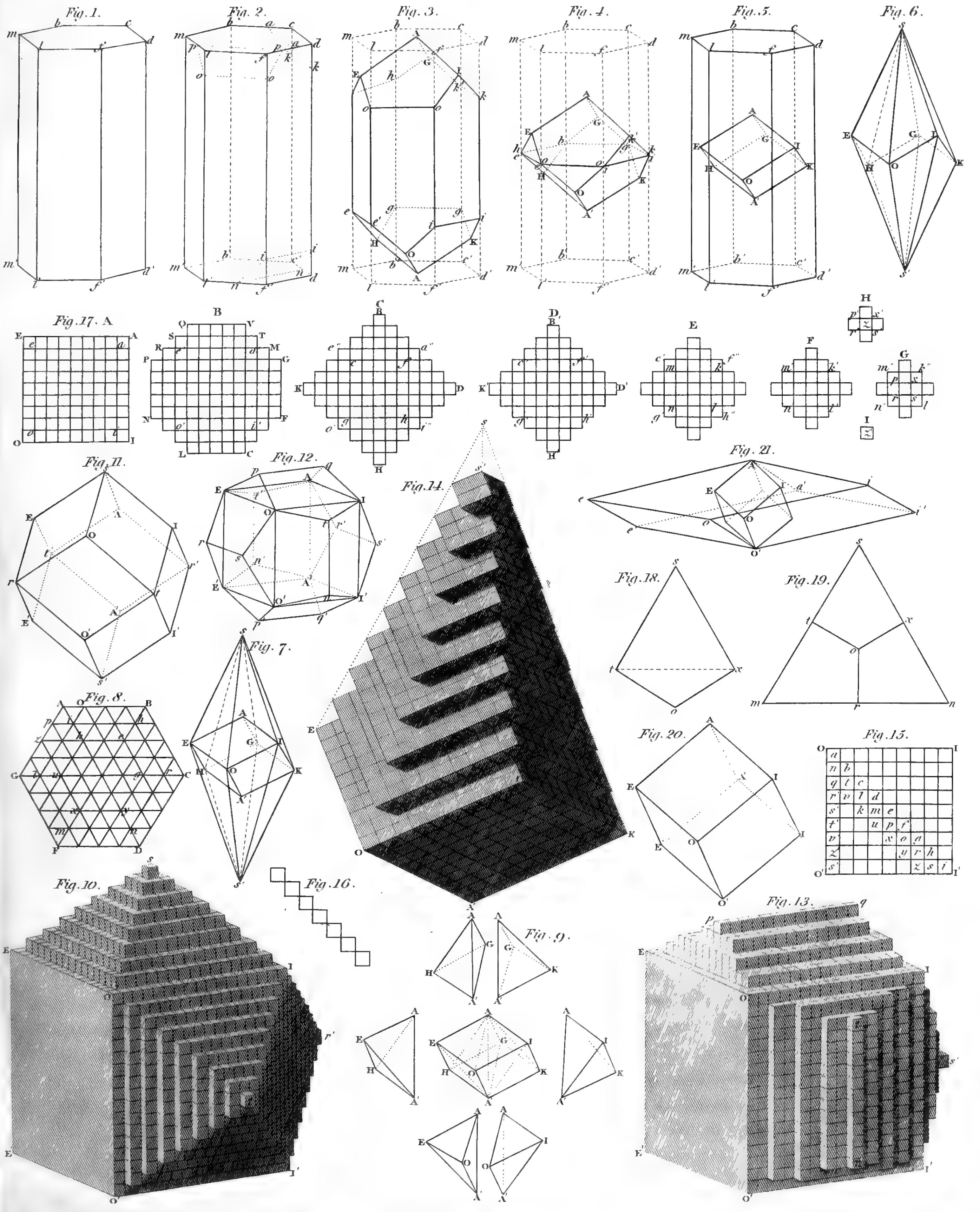
9. *Sulphate of lead.* The most common form of the crystals of this salt is the octahedron, though it occurs also crystallized in various other very irregular forms.

Muriate of copper.

10. *Muriate of copper.* This salt was brought originally from South America. It has been observed also in the lava of Mount Vesuvius. The primitive form is the octahedron, and three varieties of crystals have been described.

Arseniate of copper.

11. *Arseniate of copper.* This mineral, found first



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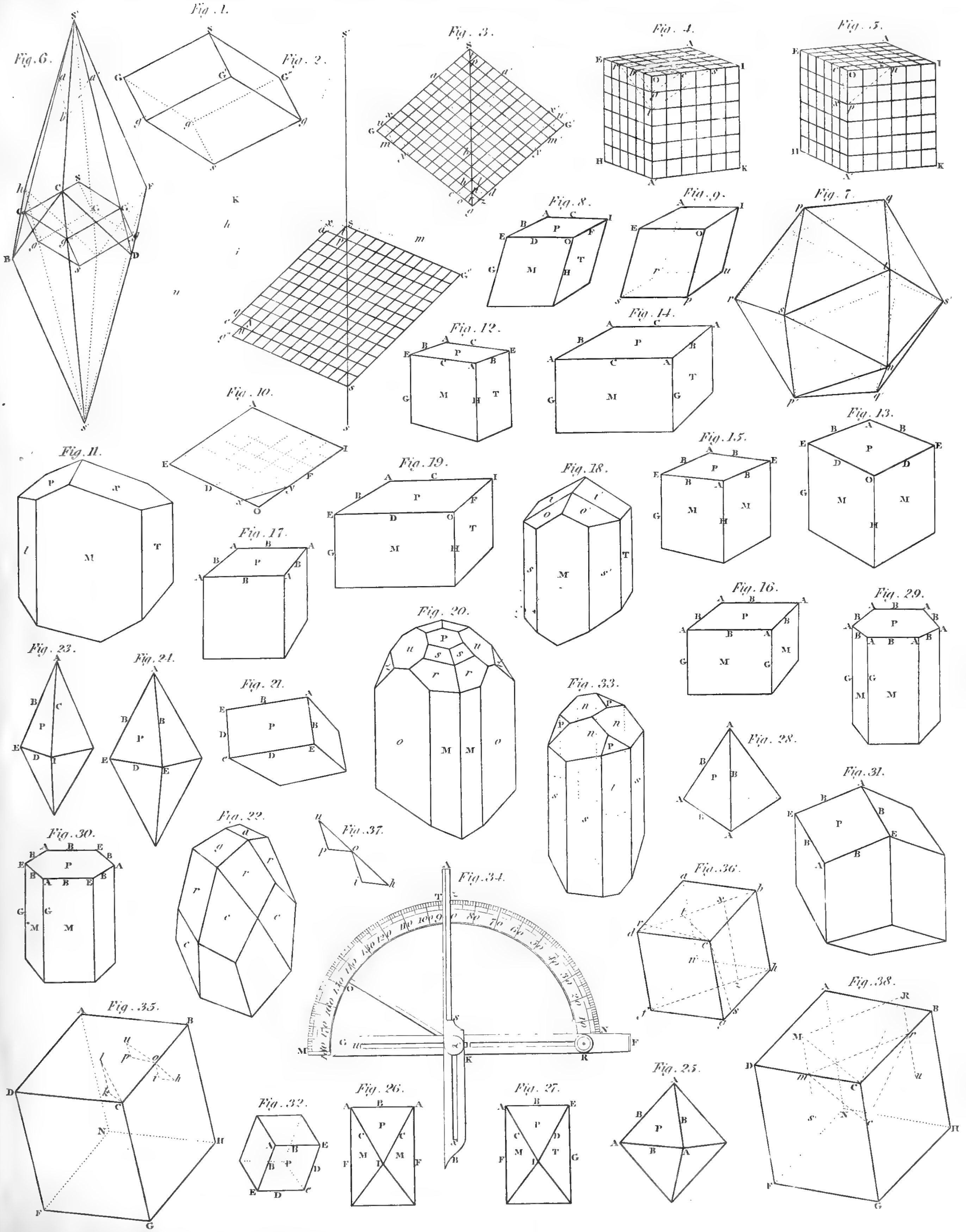

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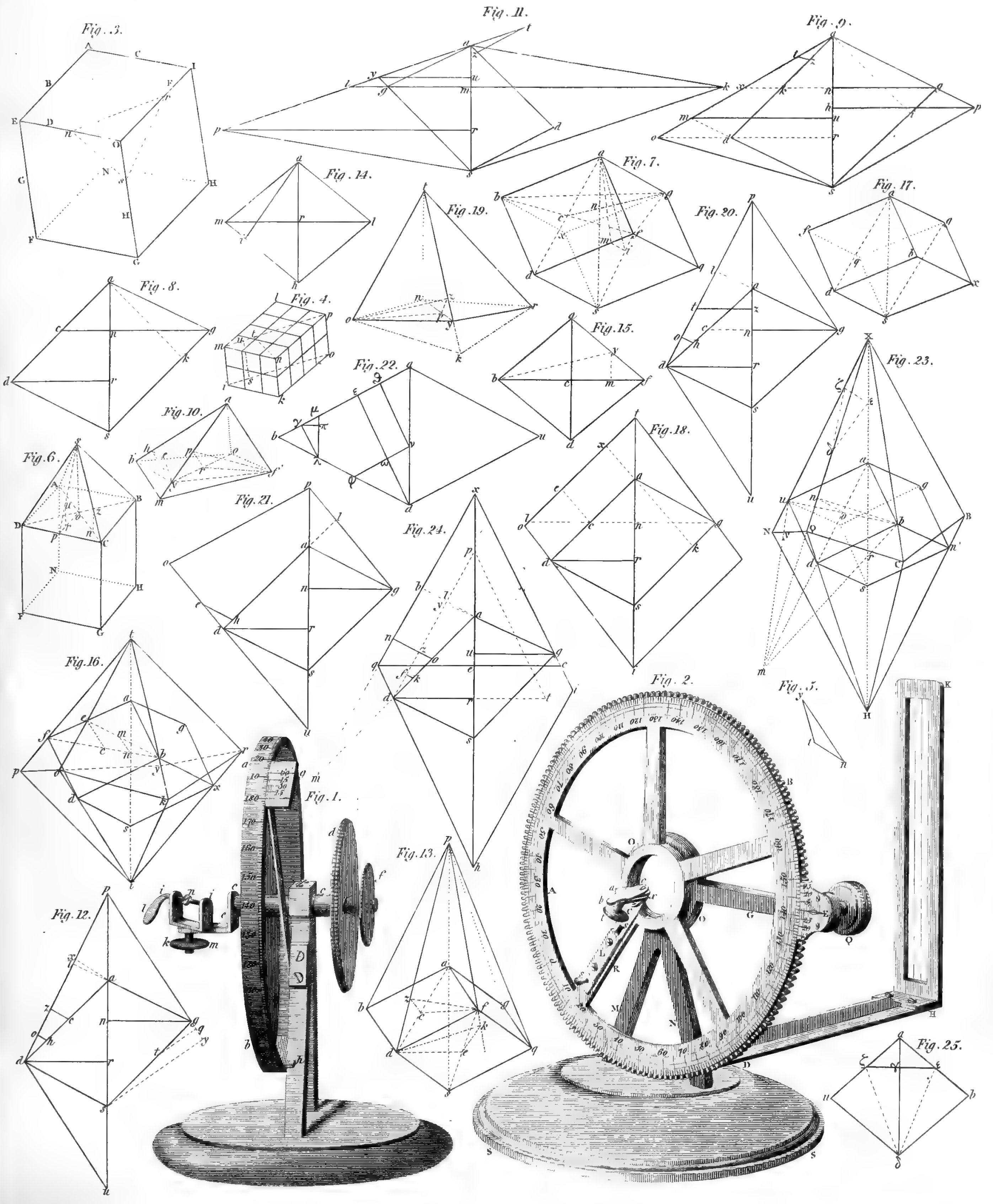

Fig. 2. Drawn by John Farey Junr. for the Edinr. Encyclopædia.

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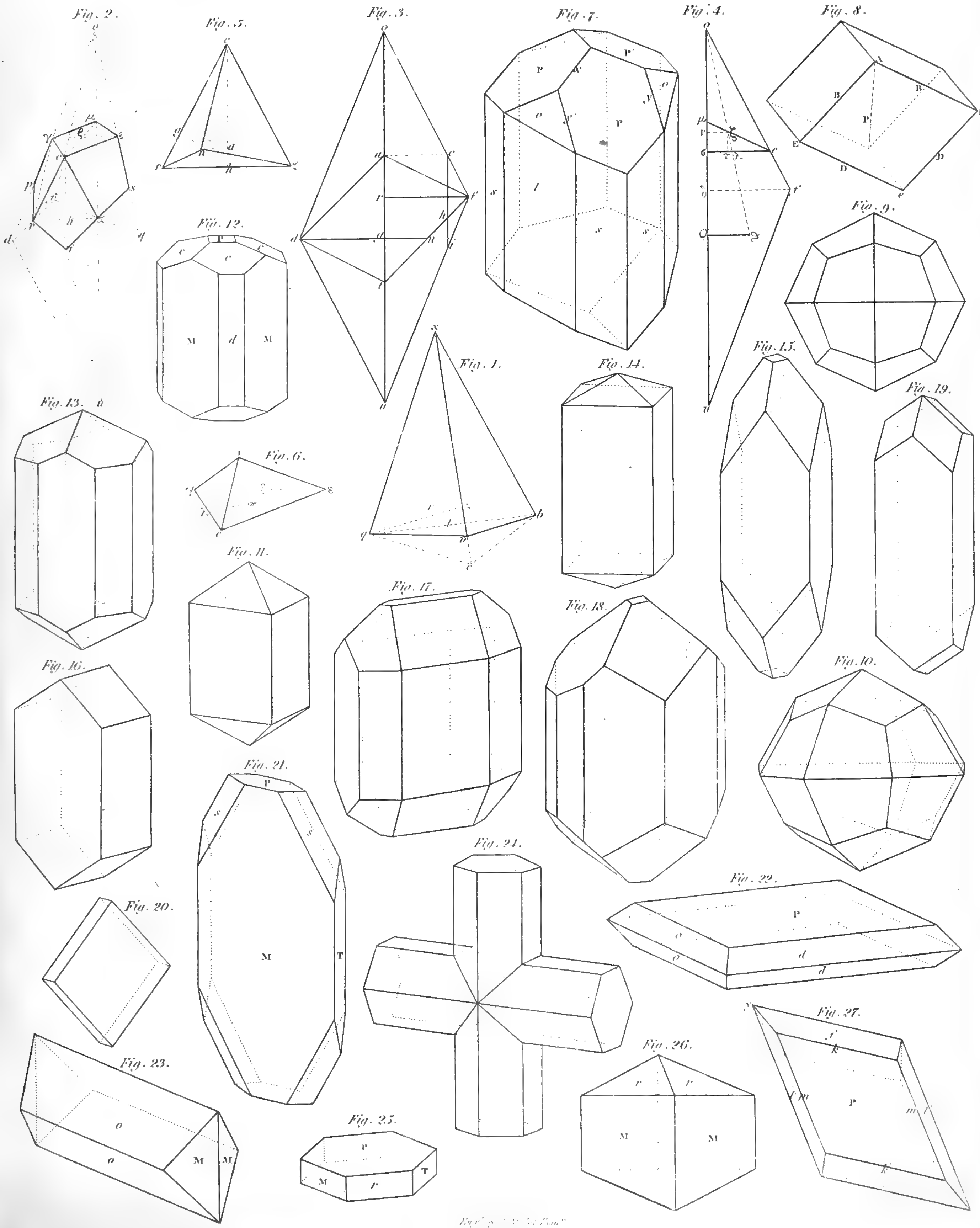
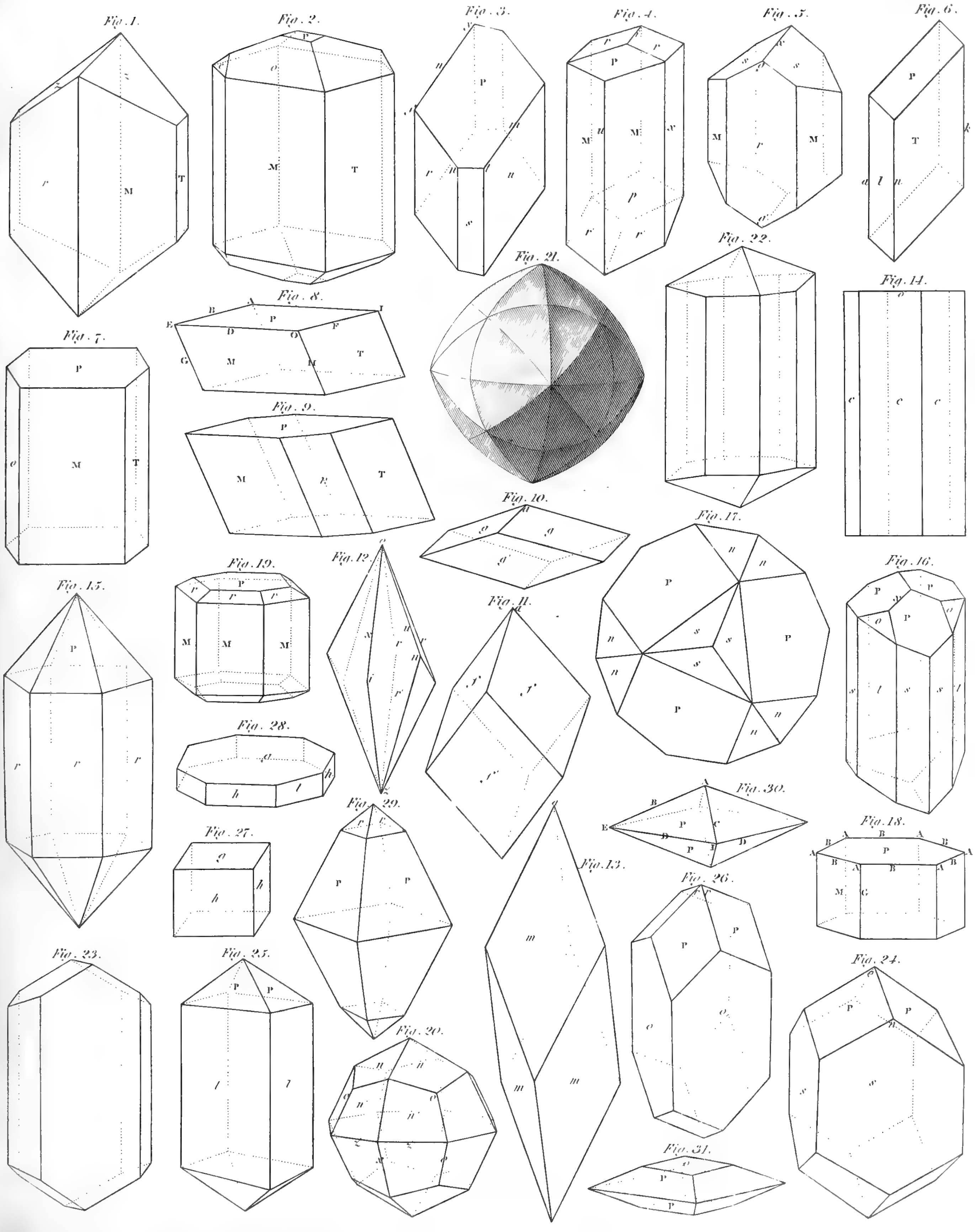


Fig. 2.
Fig. 5.
Fig. 3.
Fig. 7.
Fig. 4.
Fig. 8.
Fig. 9.
Fig. 12.
Fig. 1.
Fig. 14.
Fig. 15.
Fig. 13.
Fig. 19.
Fig. 6.
Fig. 11.
Fig. 17.
Fig. 18.
Fig. 16.
Fig. 10.
Fig. 21.
Fig. 24.
Fig. 22.
Fig. 20.
Fig. 27.
Fig. 23.
Fig. 26.
Fig. 25.

CRYSTALLOGRAPHY. *PLATE CCXXVI.*



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Crystalline Forms.

in Cornwall, has been described by Bournon in the *Philosophical Transactions.* Hauy has reduced all his species under the common laws of decrement.

Calamine.

12. *Calamine.* This mineral occurs but rarely crystallised. Hauy, however, in his *Mineralogie,* has described three varieties of form. The most common is that represented in Fig. 23.

Plate CCXXVI. Fig. 23.

III. *Pyramids having a Square Base.*

Pyramids having a square base. Mellite.

To this primitive form belong seven species of minerals; namely,

1. *Mellite,* or *Honeystone.* This singular mineral occurs crystallized in the primitive form, and in dodecahedrons differing about one degree in the inclination of the faces from the common rhomboidal dodecahedron.

Zircon.

2. *Zircon,* including the *Hyacinth.* It occurs in the primitive form, also in various other forms. The most usual are represented in Figs. 24. and 25. The symbol for the first is $\underset{s}{{}^{1}E^{1}}\;\underset{P}{P}$; for the second $\underset{l}{\underset{1}{\overset{1}{D}}}\;\underset{P}{P}$. The first is the most common form of hyacinth, the second of the jargon of Ceylon.

Figs. 24, 25.

Harmotome. Fig. 26.

3. *Harmotome, cross stone,* or *staurolite.* The most common variety of the crystals of this species is represented in Fig. 26. Its symbol $\underset{o}{{}^{1}E^{1}}\;\underset{P}{P}$.

Oxide of tin.

4. *Oxide of tin, tinstone.* Hauy at first supposed the primitive form of this species to be the cube, but he has more recently found it to be an octahedron. The crystals of this species are numerous. By far the most accurate description of them has been drawn up by Mr Philips, and will be probably published in the second volume of the *Transactions of the Geological Society of London.*

Molybdate of lead. Figs. 27, 28.

5. *Molybdate of lead.* The crystals of this species have most commonly the forms represented in Figs. 27. and 28. The symbol for the first is $\underset{h}{\overset{1}{D}}\;\underset{g}{\overset{1}{A}}$; for the second $\underset{h}{\overset{1}{D}}\;\underset{l}{{}^{1}E^{1}}\;\underset{\overset{1}{g}}{A}$.

Anatose. Plate CCXXVI. Fig. 29.

6. *Anatose* or *octahedrite.* This species consists of pure oxide of titanium; yet its crystalline form is essentially distinct from the titanite. Besides the primitive, it occurs in various forms; one of the most common of which is represented in Fig. 29. The symbol for it is $\underset{P}{P}\;\underset{\overset{3/4}{r}}{A}$. The crystals of this species are always very small.

Tungstate of lime.

7. *Tungstate of lime.* Hauy at first supposed that the primitive form of this species was the cube, but he afterwards found it to be the octahedron. It occurs usually crystallized in octahedrons.

IV. *Pyramids having a Rhomb for their Base.*

Pyramids having a rhomb for their base.

There are four species of minerals that belong to this primitive form, namely,

Carbonate of soda. Fig. 30.

1. *Carbonate of soda.* The primitive form of this species is represented in Fig. 30. The angle which the edge D makes with D′ is 120°, and the inclination of the face P to P′ is 74°. The most common crystalline form of this salt is exhibited in Fig. 31. Its symbol is $\underset{P}{P}\;\underset{\overset{1}{o}}{A}$.

Fig. 31.

Sulphur.

2. *Sulphur.* Very splendid crystals of this mineral have been brought from Spain and Sicily. It occurs in the primitive form, often lengthened edgewise, and sometimes the points of the pyramids are truncated. We give no figures, because there never can be any difficulty in distinguishing the species.

Blue carbonate of copper.

3. *Blue carbonate of copper, hydrate of copper.* This species occurs crystallized, but the crystals are so small that it is scarce possible to determine their form with accuracy. Hauy has followed Romé de Lisle, who obtained his crystals by evaporating an ammoniacal solution of copper.

Sphene.

4. *Sphene* and *titane siliceo-calcaire* of Hauy. This mineral occurs frequently in rhomboids, with their alternate angles truncated. We want still a good description of the crystalline forms which it assumes. Hauy will doubtless supply the deficiency when his new edition makes its appearance. (c)

C U B

Cuba.

CUBA, one of the largest of the West India Islands, stretches from east to west from the seventy-fourth to the eighty-fifth degree of west longitude, and lies between the parallels of 19° 56′ and 23° 18′ of north latitude. Its greatest length, from Cape Maize on the east to Cape St Antonio on the west, is 764 British miles; its greatest breadth at Cape de Cruz is 133 miles, and its least breadth 74 miles. It is about 62 miles to the west of St Domingo, 168 miles to the east of Yucatan, 96 to the north of Jamaica, and 130 to the south of Florida.

A long chain of mountains extends from east to west along the whole length of the island, and divides it into two parts. About 158 rivers and brooks have their origin in this range, and carry down with the detritus of the mountains a very fine gold, which affords reason to believe that there are mines of this metal in the interior. At the foot of these mountains are large tracts of meadow ground, called Savannas, which feed an immense number of cattle, both wild and tame, the skins of which form one of the principal articles of the commerce of the island. The skins are reckoned superior to any of those from other parts of the West Indies, and are known in Europe by the name of the skins of the Havannah, the town from which they are exported. About 10,000 or 12,000 skins were annually sent from the island.

The mountains abound in large timber, particularly the cedar and acajou, caobas, oaks, granadillos, guayacanes, and ebony trees. The fertility of the soil is great. The most delicate herbs and fruits are in full blossom the whole year round, the fields are constantly covered with flowers, and the trees never lose their foliage. Two crops are often produced annually from some of the seeds, one of the crops coming to maturity in the middle of winter. The temperature of the island is very warm and dry, and, owing to the refreshing gales from the north and east, it is more mild than that of the island of St Domingo. A great deal of rain falls in the months of July and August; but the other months of the year are hot and dry.

The principal productions of Cuba are sugar, coffee, tobacco, wax, ginger, long pepper, and other spices, mastic, aloes, vanilla, cassia, fistula, manioc, maize, cocoa, &c. The sugar cane was introduced into Cuba from St Domingo, and has been cultivated here with such success, that no fewer than 480 sugar engines have been erected. In the year 1803, there were exported from the Havannah 158,000 caxas (or chests), of 16 arrobas, or 200 kilogrammes; and from the Port of the Trinity and Santiago de Cuba, including the contraband, 3000 caxas: so that the total exportation of sugar from Cuba, in 1803, was 37,600,000 kilogrammes. The average amount of the export of sugar from the Havannah, from 1801 to 1810 inclusive, has been 2,850,000 arrobas, or about 644,000 cwt. *per annum.* The consumption of sugar in the island amounts to from 25,000 to 30,000 caxas. When M. Humboldt visited this island, he found, from the most exact calculations he could make, that a given hectare of ground yields, at an average, 12 cubic metres of *vezou*, from which is drawn by the processes hitherto in use, in which much saccharine matter is decomposed by fire, at the utmost from 10 to 12 *per cent.* or 1500 kilogrammes (3310 pounds avoirdupois) of raw sugar. At the Havannah, they reckon that a caballeria of ground, which contains 18 square *cordeles* (at 24 varas), or 133,517 square metres (1,437,163 square feet), yields *per annum* 2000 arrobas, or 25,000 kilogrammes (upwards of 50,000 pounds avoirdupois). The average produce is, however, only 1500 arrobas, or 1400 kilogrammes (3089 pound avoirdupois) per hectare (107,639 square feet.)

The establishment of a great sugar plantation in Cuba, wrought by 300 negroes, and producing 500,000 kilogrammes (1,103,500 pounds avoirdupois) of sugar, annually requires an advance of L.83,340 sterling, and brings in from L.12,500 to L.14,600 sterling. Two hundred negroes are required to produce 250,000 kilogrammes of raw sugar; and the purchase of these negroes amounts to L.12,500 sterling. The maintenance of a slave amounts to more than 16s. 8d. per month.

The tobacco manufactured in the island of Cuba is of most excellent quality; and though the cultivation of this article has of late years suffered a considerable diminution, yet it forms one of the chief branches of the royal revenue. It is exported to Europe in the form of leaf, snuff, and cigars; and is deemed superior to the tobacco from any other part of America. The best comes from the town of Trinity and from Santi Espiritus; and it is from this that the European Spaniards manufacture the celebrated tobacco of Seville. The preference given to the cultivation of coffee, and the vexations which the planters experience, have greatly reduced the produce of the tobacco farms in Cuba. In 1803, the island scarcely supplied 150,000 arrobas, whereas, in good years, before 1794, the crop was estimated at 315,000 arrobas (7,873,000 pounds*), of which 128,000 arrobas were exported to Spain, and 160,000 consumed in the island. About 56,000 pounds are annually sent to New Spain.

After the destruction of the coffee plantations in St Domingo, coffee began to be cultivated in the island of Cuba; and in the year 1804 it produced about 12,000 quintals. Bees were introduced into the island in 1763 by some emigrants from Florida; and such was the rapidity with which they multiplied in the hollows of old trees, that there was soon sufficient wax for the annual consumption. In 1777, 715,000 pounds were exported from the Havannah, of a quality equal to the wax of Venice. Including the contraband, Cuba exported, in 1803, 42,670 arrobas of wax, the price of which was then from 20 to 21 piastres per arroba; but the average price, in time of peace, is only 15 piastres, or L.3, 2s. 6d. sterling. A small part of this wax is produced by the wild *trigones*, which occupy the trunks of the *cedrela odorata*; but the principal part is the produce of the common bee.

When Cuba was first conquered by the Spaniards, a considerable quantity of gold was found in the parts now called Jagua and the city of Trinidad; and Herrera affirms that it was more pure than that of St Domingo. A small quantity is found at present at Holguin. An assiento of the mine was established here under the reign of King Don Juan de Eguiluz, when no less than 1000 quintals of gold were sent annually to Spain. There are in Cuba mines of copper and loadstone; and in the jurisdiction of the Havannah an iron mine of excellent quality has been lately discovered. Artillery, similar to that which was in the fortified places of the Havannah, Cuba, and the castle of Morro, were formerly cast here. On the road from Bayamo to Cuba are found pebbles of various sizes, and so perfectly round, that they might be used for cannon balls. There are numerous warm baths in the island, and great numbers of salt ponds. It contains also 982 herds of large cattle, 617 inclosures for fattening swine, 350 folds for fattening animals, 1881 manufactories, and 5933 cultivated estates.

The whole island is divided into two governments, viz. that of Cuba and the Havannah, which are again subdivided into jurisdictions and districts. The governor of the Havannah is captain-general of the whole island, and extended his authority as far as the provinces of Louisiana and Movila. The whole island was one diocese suffragan to the archbishopric of St Domingo; and its jurisdiction comprehended the provinces of Louisiana, and had the title of those of Florida and Jamaica. It contained 21 parishes, 90 churches, 52 curacies, 23 convents, 3 colleges, and 22 hospitals.

The town of Cuba is, properly speaking, the capital of the island, but the governor and captain-general reside at the Havannah. The following is a list of the cities, towns, and settlements.

Cities.	*Settlements.*
Havannah.	Consolacion.
Cuba.	Los Pinos.
Baracoa.	Baxa.
Holguin.	Mantua.
Matanzas.	Guacamaro.
Trinidad.	Las Tuscas.
Santa Maria del Rosario.	Yara.
San Juan de Taruco.	Las Piedras.
Compostela.	Cubita.
	Vertientes.
Towns.	San Pedro.
Bayamo.	Pamarejo.
Puerto del Principe.	Cupey.
S. Felipe and Santiago.	Arroyo de Arenas.
S. Juan de los Remedios.	Filipinas.
Santi Espiritus.	Jiguam.
Santa Clara.	Caney.
Guanavacoa.	Tiguabos.
Santiago de las Vegas.	El Prado.

* The Abbé Raynal estimated the produce only at 4,675,000 pounds.

Moron.	Alvarez.
San Miguel.	Hanavana.
El Cano.	Macuriges.
Managua.	Guanajay.
Guines.	El Ciego.
Rio Blanco.	Cacarajicaras.
Guamutas.	Pinal del Rio.

The island of Cuba contains 11 very large and convenient bays, and many secure harbours, of which the principal are the port of Havannah, and the bay of Mataca. The harbour of the Havannah is large and safe, and is capable of containing about 1000 vessels. It possesses numerous and excellent fortifications, and has always been regarded as the military port of Mexico. A hostile squadron can anchor only at the foot of the castle of Saint John D'Ulua, which rises like a rock in the middle of the sea; and it is generally supposed that this fort is capable of holding out till the land-forces descend from the central table land, and till the health of the besiegers is affected by the insalubrity of the climate.

The bay of Mataca is very deep and spacious. It receives the sea by a very large canal; and, in consequence of two or three rivers discharging themselves into the bay, it is much frequented, both from the facility of procuring water, and from the abundance of refreshment which can be obtained.

Owing to the great expence of maintaining the squadrons which were stationed at Cuba during the last war, the sum required for the interior administration of Cuba is very great, amounting to no less than 1,826,000 piastres. This sum is made up of the following items, taken at an average from the years between 1788 and 1792.

	Piastres.
1. Aid to the internal government, *attencion de tierra*, for Santiago de Cuba	146,000
Ditto for the Havannah	290,000
2. Maritime expences, *attencion maritima* *	740,000
3. Expence of maintaining the fortifications of the Havannah	150,000
4. Purchase-money of tobacco from the island of Cuba, which goes into Spain	500,000
	1,826,000

These enormous charges almost entirely swallow up the revenues which the royal treasury receive from the island, which amounted only to 2,500,000 piastres, not including the annual situado from Mexico.

In the spring of 1804, when Humboldt was in Cuba, the following was its military state:

	Men.
1. Disciplined militia (infantry) at the Havannah	1,442
At the Villa de Puerto del Principe	721
2. Disciplined militia (cavalry) at the Havannah, and its jurisdiction	517
3. County militia (undisciplined) to the east of the Havannah and of Matanzas	7,995
To the west of the Havannah	5,688
In the suburbs of the Havannah	1,368
In the jurisdiction of the four towns	2,640
In that of the Puerto del Principe	1,728
In that of Santiago de Cuba	2,412
Total force	24,511

Humboldt is of opinion, that Cuba could command for its defence a body of 36,000 whites, from the age of 16 to 45.

The island of Cuba is supplied with a great quantity of provisions, but especially salt meat, from the coast of the Caraccas; but in the time of a war with England, the navigation to the Havannah is extremely dangerous, from the necessity of doubling Cape St Antonio. To avoid these dangers, an interior communication between the northern and southern coasts of the island has been projected. It is proposed to open a navigable canal for flat boats, through an extent of eighteen leagues, from the Gulf of Batabano to the Havannah, passing through the beautiful plains of the district of Los Guines. This canal will require few locks, and will not only fertilize the country by irrigation, but will convey to the Havannah, by a short and a safe route, the salted provisions, cocoa, indigo, and other productions of the Terra Firma.

The population of the island of Cuba, in 1774, amounted only to 171,628 inhabitants, including 44,328 slaves, and from 5000 to 6000 negroes. The number of negroes brought into Cuba, from 1789 to 1803, exceeded 76,000; and during the last four years of this period the number was 34,500, or more than 8600 annually. In 1804, according to Humboldt, the population of the island stood thus:

1. Freemen,		
Whites	234,000	
People of colour	90,000	
		324,000
2. Slaves		108,000
Total population,		432,000

That is, in every 100 inhabitants there are 54 creole and European whites 21 men of colour, and 25 slaves.

The following important geographic positions in the island of Cuba, and the small adjacent islands, we owe to M. Humboldt:

	Long. West from Greenwich Observatory.	Latitude.
The Havannah, the Morro	82° 22′ 53″	23° 9′ 27″
The Trinidad of Cuba	80 0 51	21 48 20
Cape St Antonio, N. W.	84 57 7	21 55 0
Punta de Mata, Hambre	82 17 30	
Bocca de Xagua	80 34 7	
Cayo Flamingo	81 43 7	22 0 6
Cayo de Piedras	81 16 57	21 56 40

This island was discovered by Columbus in 1492, and in 1494 it was circumnavigated by Nicholas de Obando.

See Humboldt's *Political Essay on the Kingdom of New Spain*, passim; Raynal's *History of the East and West Indies*; Thomson's *Alcedo*; and Peuchet's *Dictionnaire de la Geographie Commerçante*. See also the article HAVANNAH, and WEST INDIES. (*w*)

CUBÆA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 210.

CUCKOO. See ORNITHOLOGY.

CUCUBALUS, a genus of plants of the class Decandria, and order Trigynia. See BOTANY, p. 217.

CUCULLARIA, a genus of plants of the class Monandria, and order Monogynia See BOTANY, p. 82.

CUCULUS. See ORNITHOLOGY.

CUCUMIS, a genus of plants of the class Monœcia, and order Monadelphia. See BOTANY, p. 330.

* This includes 700,000 piastres for the port and dockyards of the Havannah, and 40,000 for the vessels stationed off the coast of the Mosquitos

CUCURBITA, a genus of plants of the class Monœcia, and order Monadelphia. See BOTANY, p. 330.

CUDDALORE, a town of Hindostan, on the coast of Coromandel, situated about a mile to the south of Fort St David. The town is about three quarters of a mile long from north to south, and extends about half a mile from east to west. It is fortified on three sides, the side towards the sea being in a great measure open. The river, however, which passes between Fort St David and the town, flows along the eastern side of the city, and has thrown up a huge mound of sand at its embouchure, which in some means supplies the place of a fortification. The river, which is small, and navigable only by boats, is shut up by a bar at its mouth. The pagoda of Trivada, which forms a citadel to a large pettah, or town, stands a little above Cuddalore. The places which give a safe anchorage are 1½ mile from the shore, the flagstaff bearing N. W. and Fort St David N. N. W.

The town is populous, and carries on a considerable trade. Dimities, and various kinds of piece goods, similar to those of Surat in dimensions, colour, and qualities, are manufactured at Cuddalore, and the prices are nearly the same as at Surat.

In the year 1686, Mr Elihu Yale purchased the site of this town, and a small district, for the use of the India Company, for £31,000, from a Mahratta prince, and the fortifications gradually acquired strength. The French, under General Lally, took the place on the 1st of June 1758, after a siege of five weeks. The fortifications were completely destroyed; but when the town was restored to Britain at the peace, it soon recovered its prosperity. It was again taken by the French in 1781; and in 1783, after a severe contest, it fell into the hands of the British. East Long. 79° 50′, North Lat. 11° 43′. See Milburn's *Oriental Commerce*, vol. i. p. 376, Lond. 1813. (π)

CUDWORTH, RALPH, a celebrated metaphysician and divine, was born in 1617, at Aller, in Somersetshire, where his father was rector. After receiving the usual course of education, partly under the care of his father, and partly under that of his father-in-law, he was admitted, at the early age of thirteen, as a pensioner of Emanuel College, Cambridge, where he was matriculated in the year 1632. Having taken his degree of Master of Arts in 1637, and being elected a fellow of Emanuel College in the following year, his reputation as a tutor became so great, that he had no fewer than twenty-eight pupils at one time, among whom were the celebrated Sir William Temple and Archbishop Tillotson. He was soon afterwards appointed by his college to the rectory of North Cadbury, in the county of Somerset. In 1642, he published *A Discourse concerning the true Nature of the Lord's Supper*, and *The Union of Christ and the Church Shadowed, or in a Shadow*. In 1644, Cudworth took the degree of Bachelor of Divinity, and in the same year he was elected Master of Clarehall, when Dr Paske was ejected from that situation by the parliamentary visitors. In 1645, he was elected Regius Professor of Hebrew; and he now devoted the whole of his attention to his studies and academical duties. In 1651, he took the degree of Doctor in Divinity; but, owing to the embarrassed state of his finances, he was compelled for a while to quit the university. He was, however, speedily recalled, and in 1654 he was appointed to the head of Christ's College, Cambridge; a situation in which he spent the remainder of his days. In the year 1656–7, he was one of the persons who were nominated by a committee of parliament to deliberate about a new translation of the Bible. After the restoration of Charles II. he was presented to the vicarage of Ashwell, in Herefordshire; and in 1678, when he was installed prebendary of Gloucester, he published his great work, entitled *The True Intellectual System of the Universe, the first Part, wherein all the Reason and Philosophy of Atheism is confuted, and its impossibility demonstrated.* The principal object of this work is to refute the principles of atheism; and in the execution of this task, he has combined a great acuteness of reasoning with the most profound knowledge of ancient literature. His attachment, however, to the Platonic philosophy, has thrown an air of mysticism over some of his metaphysical opinions; and his doctrine of the Plastic nature, is supposed by Bayle to have given great advantage to the Atheists.

Beside the works which have been mentioned, Cudworth published some Sermons, and has left behind him several manuscripts, which are now lodged in the British Museum. The following is a list of them:

1. A Treatise concerning Moral Good and Evil.
2. A Treatise of Liberty and Necessity, wherein the foundations of the philosophy of atheism are destroyed, the certainty of morality established, and the nature of it explained.
3. A Commentary on the Seventy Weeks mentioned by the prophet Daniel, wherein the several explications of them by the Jews and some Christian writers are examined and confuted. 2 vols, folio.
4. A Treatise on the Creation of the World, and the Immortality of the Soul. 1 vol. 8vo.
5. Of the Learning of the Hebrews.
6. An Explanation of Hobbes' Notions concerning the Nature of God, and the Extension of Spirits.

Cudworth died at Cambridge in 1688, in the 71st year of his age. See the article ATHEISM, for an account of his *Intellectual System*. (o)

CUELLARA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 222.

CUENCA, SANTA ANA DE, the capital of a province of the same name in the kingdom of Quito, is situated in the delightful plain of Yunquilla, which is about six leagues and a half long, and as many in width. This valley is watered by four rivers: the Machangara, which runs about half a league to the north of the city; the Matadero, which runs close to the south side of the city; the Yanuncay, which is distant from Cuenca about a quarter of a league; and the Los Banos, which is at the same distance. All these rivers, which are crossed by bridges, and are at some seasons fordable, unite at a small distance from Cuenca, and form the large river of Pante.

The city of Cuenca is classed by Ulloa among those of the fourth order, and is regarded as one of the most beautiful in the kingdom. The streets, which run in straight lines, are tolerably broad. The houses, which are generally of one story, are built with unburnt bricks, and are covered with tiles; and the suburbs, which the Indians inhabit, are, as usual, mean and irregular. The parish church, which was erected into a cathedral in 1786, is a magnificent building. The hospital is handsome and convenient, and well attended. The five convents, viz. of the order of St Francis, St Domingo, St Augustin, St Peter Nolasco,—the college, which formerly belonged to the Jesuits,—the two monasteries of nuns, viz. that of La Conception and of Santa Teresa, are all buildings of a very superior order.

The climate of Cuenca is mild and healthy; but sudden tempests, accompanied with dreadful thunder and lightning, often take place when the sky is clear. Every kind of flesh; and pulse, vegetables, and fruits, abound in the neighbourhood.

The women of this province are very industrious; and the baizes and other articles which they fabricate, which are esteemed for their quality and brilliancy of colour, form a great article of commerce. A hat manufactory was established here some years ago, which has proved one of the best and most useful in the city. Sugar is made in great quantities, and is in high repute; and the conserves of fruits, called the *caxetas de Cuenca*, are much admired. Large cheeses, resembling those of Parma, are made in Cuenca, and find a ready sale in Lima, Quito, and other cities. In the territory to the south of the city is the height of Tarqui, where the base was measured by Bouguer and Condamine for their trigonometrical operations. This city was founded in 1557 by Gil Ramirez Davalos. Ulloa states the population of this town at 20,000 or 30,000; but, according to much later accounts, it does not exceed 14,000. West Long. 79° 14′ 15″, South Lat. 2° 55′ 3″. See Peru and Quito. (π)

CULDEES, a body of religious, who chiefly resided in Scotland, Ireland, and some of the adjacent isles. The name has been also written *Keldees* and *Kyldees*. Various etymons have been given of it. Two of these seem to have superior claims to attention. It may be deduced either from Irish *ceile*, or *gille*, a servant, and *De, Dia*, God; or from *cuil, ceal*, in Welsh *cêl*, a sequestered corner, a retreat. The latter seems to derive support from the established sense of *Kil*, retained in the names of so many places, which, in an early age, have been consecrated to religion.

It is more than probable, that Christianity had found its way into Scotland before the close of the second century; and that it continued to be professed by a few scattered individuals, even before the arrival of Ninian, in the beginning of the fifth. But we have no proof of the existence of any religious societies observing a particular institute till the year 563, when Columba landed in Hii, or Iona; which, in honour of him, was afterwards called *I-colum-kill, i. e.* the *isle* of *Colum*, or Columba, of the *cells*. He was born in Ireland, A. 521; and, after founding many seminaries of religion there, prompted by zeal for the propagation of Christianity, set sail for Scotland with twelve companions. According to Bede, having converted the northern Picts, he received from Brudi, their king, the island of Hii in possession, for the purpose of erecting a monastery. Here he almost constantly resided till the year 597, when he died. He made occasional visits to the mainland, proceeding even as far as to Inverness; also to Ireland, where he was held in high estimation. As he was himself much devoted to the study of the Holy Scriptures, he taught his disciples to confirm their doctrines by testimonies brought from this unpolluted fountain, and declared that only to be the divine counsel which he found there. His followers, faithful to his instructions, "would receive those things only which are contained in the writings of the prophets, evangelists, and apostles, diligently observing the works of piety and purity;" Bede, *Hist.* iii. 4. They lived, indeed, according to a certain institute, which, it is said, was composed by their venerable instructor. But there was this remarkable distinction between them and those societies properly called monastic, that they were not associated expressly for the purpose of observing this rule. While they seem to have reckoned something of this kind necessary for the preservation of order, and for the attainment of habits of diligence, their great design was, by the instruction of those committed to their charge, to train them up for the work of the ministry. Hence it has been justly observed, that the Culdean fraternities may more properly be viewed as colleges than as monasteries, as being, in fact, the seminaries of the church both in North Britain and in Ireland. There were also Culdees in Wales; and for many ages, the Christians of that country held the same doctrines, and observed the same rites, with their Scottish and Irish brethren. The presbyters not only acted as the ministers of religion to those in their vicinity, but were still instructing others, and sending forth missionaries whenever they had a call, or any prospect of success.

In each regular establishment of the Culdees, it would appear that there were twelve brethren, with one who presided over them. Their ecclesiastical government has been viewed as materially the same with the Presbyterian. Their president, or abbot, was not a bishop, but a presbyter; to whose authority, as we learn from Bede, even the bishops of the district were subject. In their meetings, all matters were settled by plurality of voices. The members of this council had the general designation of *seniores*, or elders. To them, collectively, belonged the trial of the gifts of those who had been educated in their seminaries, when they were to be employed in the public ministry; from them they received ordination and mission; and to them they were amenable in the discharge of their office. Those whom they thus employed are, by ancient writers, often denominated *bishops*. But that they attached to this designation no dignity superior to that of *presbyter*, appears incontrovertible from their being afterwards called to account, and sometimes censured by the fraternity. It has been asserted, by the friends of diocesan episcopacy, that a bishop *must* always have resided at Iona for the purpose of conferring ordination. But there is not the slightest evidence of this. The contrary appears from all the records of these early ages. We learn from the Saxon Chronicle, that "there was always an abbot at Hii, but no bishop."

It is a singular fact, that those who were first acknowledged as bishops in the northern parts of England, and were indeed instrumental in the introduction of Christianity there, were not only trained up at Iona, but received all their authority from the council of seniors in that island. This was the case with respect to Corman, the bishop of the Northumbrians, as well as Aidan, Finan, and Colman, who succeeded each other in this mission. From the testimony of Bede it is evident, that by means of Scottish missionaries, or of those whom they had instructed and ordained, not only the Northumbrians, but the Middle-Angles, the Mercians, and East-Saxons, all the way to the river Thames, that is, the inhabitants of by far the greatest part of the country now called England, were converted to Christianity, and for some time acknowledged subjection to the ecclesiastical government of the Scots. The latter lost their influence, merely because their missionaries chose rather to give up their charges, than to submit to the prevailing influence of the church of

Rome, to which the Saxons of the West and of Kent had subjected themselves. See Bede, *Hist.* iii. 21—26.

The seniors at Iona did not confine their attention to England. They established religious houses, similar to their own, in many places in Scotland. The most ancient of these seems to have been at Abernethy, accounted the capital of the Pictish kingdom. The Culdean monastery, or college there, appears to have been founded about the year 600. The idea, that this was the primary seat of the chief episcopate among the Picts, which, it is said, was afterwards transferred to St Andrews, most probably originated from the misapprehension, or misrepresentation, by monkish writers, of the power that belonged to the Culdean council, which, in an early age, might extend over a great part of Scotland, by reason of the remote situation of Iona. It appears that there was a society of Culdees in St Serf's isle, in Lochlevin, before the close of the seventh century. They were soon after this established at Dunkeld; long before it became an episcopal see. The Pictish princes were disposed to make this a second Iona, either because of the distance, or on account of the desolation, of the other by the invasions of the Scandinavians. Hence the *abbot* of Dunkeld was also called *primate* of Pictland. The Culdees, it would seem, had a foundation at St Andrews about the beginning of the ninth century. They were settled at Brechin before it was made a bishopric. We have some proof of their establishment at Dunblane about the year 1000. They were also fixed at Monimusk, Dunfermline, and Scone. Kirkaldy, Culross, and Melrose, are numbered among their seats, as well as Govan, Abercorn, Tyningham, &c.

Their doctrines were not less unpalatable, than their mode of government, to the friends of the church of Rome. In England, in a very early period, the adherents of the popish missionary Augustine were viewed by the delegates from Iona in the light of heretics. They accordingly refused to hold communion with them. Matters were carried so high in support of the Roman authority in the synod of Stroneschalch, now Whitby, in England, A. 662, that Colman, the Scottish bishop of Lindisfarne, left his bishopric, and with his adherents returned to Scotland. Thus, as Bede informs us, "the catholic institution daily increasing, all the Scots who resided among the Angles either conformed to them, or returned to their own country;" *Hist.* iii. 25, 26, 29. It was decreed in the council of Cealhythe, A. 816, that no Scottish priest should be allowed to perform any duty of his function in England. But in Scotland the Culdean doctrine had taken deeper root, and, although equally offensive to the votaries of Rome, kept its ground for several centuries. The popish writers themselves celebrate the piety, the purity, the humility, and even the learning, of the Culdees; but while they were displeased with the simplicity, or what they deemed the barbarism of their worship, they charged them with various deviations from the faith of the Catholic church. It was not the least of these, that they did not observe Easter at the proper time. They did not acknowledge auricular confession; they rejected penance and authoritative absolution; they made no use of chrism in baptism; confirmation was unknown; they opposed the doctrine of the real presence; they withstood the idolatrous worship of saints and angels, dedicating all their churches to the Holy Trinity; they denied the doctrine of works of supererogation; they were enemies to the celibacy of the clergy, themselves living in the married state. One sweeping charge brought against them is, that they preferred their own opinions "to the statutes of the holy fathers."

The Scots, having received the Christian faith by the labours of the Culdees, long withstood the errors and usurpations of Rome. It was not till the twelfth century that their influence began to decline. Till the close of the eleventh, it appears that they continued to differ from the Romish church as to the time of observing Lent and Easter. The pious Margaret, queen to Malcolm Canmore, who has been canonized as the patroness of Scotland, being an Anglo-Saxon princess, and having been educated on the continent, may well be supposed to have been partial to those modes of worship to which she had been accustomed from her infancy. We find, accordingly, that she was offended at "certain erroneous practices" which prevailed in the Scottish church; and, with the view of reforming these, held frequent conferences with the clergy, in which the king acted as interpreter. Her arguments, as we learn from Turgot, her confessor, at length prevailed. They agreed to observe Lent according to the Catholic institution. The same writer says: "In some places of Scotland there were certain persons who were accustomed to celebrate masses, I know not by what barbarous rite, contrary to the universal practice of the church." He adds, that "the queen, from holy zeal, was at the greatest pains to annihilate this custom, that no one of the Scottish nation might henceforth presume to observe it;" *Vit. Margaret.* c. 2. s. 16. Papebroch, in his Notes, strangely views the word *missæ* as signifying *fairs.* Lord Hailes does not seem to have understood the meaning of this crimination. Vid. *Annals*, i. 38, 39, N. But this is the very charge that was afterwards brought against the Culdees in the Register of the Priory of St Andrews, supposed to have been written about the year 1140. They "celebrated their office, *after their own manner*, in a certain very small corner of the church." *More suo* of the Register, is equivalent to *nescio quo ritu barbaro* of Turgot. This also exactly accords with the account given by the celebrated St Bernard of the Irish Culdees, when Malachy entered on the bishopric of Connor. "He never had met with any," he says, "so perverse in their manners, so beastly in their rites, so impious in their faith, so barbarous as to their institutes;" *Vit. Malach* c. 6. *ap. Messingham*, p. 357. The similarity of the language used in the Register of St Andrews to that of Turgot, affords a proof that, notwithstanding the concessions made to the zealous queen, the influence of her exertions had not outlived herself.

We hear of no further attempts against them till the reign of Alexander I. He, although attached to St Columba, thought the modes of worship observed by his followers too simple; and therefore "delivered up the church" at Scone, which had been dedicated in honour of the Holy Trinity, "to God himself, and St Mary, and St Michael, and St John, and St Laurence, and St Augustine." Vid. *Chart. Dalrymple's Coll.* p. 371, 372. His brother David, *the Saint*, pursued measures still more effectual. These were at first of an artful description. As he increased the number of the episcopal sees, which tended greatly to weaken the authority of the Culdees; he promoted some of the abbots of their monasteries to the dignity of the episcopate, preserving to the Culdees, possessed of parochial churches, their benefices during life. Those whom he appointed to the other bishoprics, when they became vacant, were generally foreigners, who had been strictly trained up in the Romish religion. But the great plan devised for the overthrow of the Culdees, was the introduction of *Canons Regular* into the places which they had formerly possessed. These had been made a permanent order in the eleventh century; and, being patronized by the Pope, were rigidly devoted to the interests and forms of the church of Rome, and zealous for the extension of the authority of their ghostly father. The professed design of their introduction was, that "*religion* might be established," the country being represented as previously in a state of heathenism. *Wyntown's Cron.* B. vii. c. 6. v. 125. In some instances, where canons were introduced, the Culdees were permitted to retain their rights, and to live for a time distinctly; in others they were tolerated, if they would consent to live according to the canonical rule. As, in episcopal sees, they had exercised the right of electing the bishops, this privilege was taken from them, and conferred on the canons. Their lands, tithes, and other rights, even their churches and convents, were gradually wrested from them, and conferred on their antagonists. When at length reluctantly reduced to the necessity of appealing to the Pope, delegates were appointed who were known to be inimical to their interests; and such decisions were given as weakened their power still more. We have no historical account of their existence as a distinct body later than the year 1309, about which time those of St Andrew's at least were completely "subjected to the bishop."

It is singular, that even in Iona an attempt had been made, as early as the beginning of the eighth century, to effect a partial conformity between the Culdees and the church of Rome. Adomnan, their abbot, in consequence of a visit to the Saxon monks of Girwy, became a proselyte to their unimportant dogma, as to the time of the observation of Easter. The Culdees, however, continued firm in their adherence to the custom of their predecessors. Nectan III. king of the Picts, having adopted the catholic system on this head, resolved to accomplish by force what Adomnan had failed to do by persuasion. We learn, accordingly, from the Annals of Ulster, that, A. D. 716, he "expelled the family of Hii beyond Drum-albin." This can be understood of those only who were refractory; for Ecgberht, a Saxon monk, was at this very time sent from Girwy to Iona, where he remained for thirteen years. From him the monks of this island "received the catholic rites of life." Bed. *Hist.* vol. xxi. During his residence here, a considerable number of the Culdean presbyters had voluntarily retired to Ireland; and had done so, as refusing to submit to the Romish innovations. For there, it is said, "the law was renewed;" *i. e.* they observed their own customs without disturbance. After the death of Nectan, and of Ecgberht his ghostly coadjutor, they returned to Iona. Here the society enjoyed tranquillity for more than sixty years. During several succeeding centuries, they were harassed by oppressors still more severe; their island being frequently desolated by the Danes.

After the erection of the greater Culdee establishments on the mainland, those especially of Abernethy, Dunkeld, and St Andrew's, the religious influence of the parent foundation necessarily declined. But, amidst accumulated hardships, it subsisted so late as the beginning of the thirteenth century; for, in the year 1203, when Ceallach had erected a monastery in the island, apparently for the reception of one of the Romish orders, it was demolished by "the learned of the place," abetted by the clergy of the north of Ireland.

With respect to the Culdees on the mainland, it has been seen that they retained their corporate form, in some places at least, till the beginning of the fourteenth century. The very year in which they are last mentioned in our records as a body, is that assigned to the appearance of those contemptuously called *Lollards* in Germany. Soon after, Wickliffe propagated that doctrine in England, which formed the basis of the Reformation. In the following century, many of those who adhered to the same doctrine were branded with the name of *Lollards* in Scotland. Thus, although we cannot trace the Culdees down to the very era of the Reformation, there is reason to think, that individuals, adhering to their principles, continued to discharge the pastoral duties, especially in those places which were more remote from the episcopal seats. It has been viewed as no contemptible proof of the permanent regard which the Scots had to the memory of the Culdees, that, as soon as they had the power in their hands, they preferred a form of ecclesiastical government nearly allied to that which had so long subsisted among these venerable presbyters. To the same source, perhaps, ought we to trace the hereditary antipathy which has been manifested by the Scottish nation to pomp and ceremony in divine worship. Hence, all the power of the civil government has, even in later times, been unable to give a permanent establishment to prelacy. The account given of the Culdees, nearly a thousand years ago, would seem to be permanently descriptive of the Scottish character in matters of religion; "*Suum officium* more suo *celebrabant.*"

It is universally admitted, that the difference between the lower classes of society in England and those of the same description in Scotland, both with respect to religious knowledge and moral conduct, is very striking. Some writers, whose attention has been arrested by this singular circumstance, and who could not be influenced by local attachments, have ascribed the disparity to the relative influence, however remote it may seem, of the doctrine and example of the Culdees. Notwithstanding their great disinterestedness and diligence in propagating the gospel in England, these good men, it has been remarked, within thirty years after the commencement of their mission, were obliged to give way to the adherents of Rome; whereas the Scots, it is certainly known, enjoyed the benefit of their labours for more than seven centuries, and seem to have still retained their predilection for the doctrines and modes which they so early received.

See Dr Jamieson's *Historical Account of the ancient Culdees, and of their Settlements in Scotland, England, and Ireland;* Edin. 1811. (J.)

CULLEN, William, M. D. a late eminent physician and celebrated professor of medicine in the University of Edinburgh, was born in the county of Lanark, in the west of Scotland, on the 11th of December 1712. His parents were respectable, but not in affluent circumstances; and we have only been able to learn that his father filled the office of bailie or magistrate of the burgh of Hamilton. Of his early education no circumstances have reached our knowledge; but it is probable that, after the ordinary initiation in Latin at the school of his native parish, he might enjoy the usual advantage of a short course of classical study in the neighbouring university of Glasgow, preparatory to entering upon professional pursuits. At an early period he was bound apprentice to a surgeon apothecary in

Glasgow, during which service he would doubtless attend such medical lectures as were then given in the university of that city.

On the expiry of his apprenticeship, he made several voyages as surgeon to a West India ship which sailed from the port of London: but, not relishing that mode of life, he settled, while yet very young, as a country surgeon in the parish of Shotts, a rural district only a few miles east from Glasgow, where he could merely have earned a scanty and precarious income by his practice among poor farmers and cottagers. Even here his uncommon attainments in science, the well-tempered vivacity of his conversation, and the rare urbanity of his manners, soon acquired him a respectable acquaintance among the gentlemen of the neighbourhood, by whom he was considered as an attentive, enlightened, and humane practitioner, and a most engaging and instructive companion in the hours of social intercourse. At this early period, an incident occurred that had considerable influence on his future fortunes, and shews the extensive progress he had already made in the branches of study connected with his professional pursuits. Archibald Duke of Argyle, who long bore almost unrestrained sway in the politics of Scotland, happened to visit a gentleman of some consequence near Shotts. The Duke, who did not confine his attention to politics, was, at that time, engaged in some chemical research that required elucidation by experiment, and was in want of apparatus for the purpose. On stating his difficulties to his host, Cullen was immediately mentioned as a person who might probably be able to assist him, and was accordingly introduced to his Grace, who was much pleased with the scientific attainments and polite address of the young village doctor, and afterwards promoted his views of professional advancement on several occasions.

After a short residence in the parish of Shotts, he removed to the town of Hamilton, entering into copartnery with William Hunter, a young man in similar narrow circumstances with himself, and of congenial talents. One chief object of this connection was to enable the contracting parties to prosecute their studies, by means of the emoluments arising from their joint practice. Cullen is said to have engaged chiefly in the medical department, while Hunter devoted himself to surgery and midwifery, to which it seems the nerves of Cullen were not adequate. It was agreed between them, that they should prosecute their studies in alternate winters, that while the one was thus employed the other should conduct the business at home, and that each should be at liberty to attend the medical school that he might prefer. Cullen had the first turn in this singular agreement, so honourable as well as advantageous to both, and made choice of the University of Edinburgh, which was then fast rising into fame as a school of medicine, and to the celebrity of which he afterwards so largely contributed. Next winter, Hunter gave the preference to London, probably attracted by the superior advantages which it afforded for the study of anatomy, surgery, and midwifery. And meeting with great encouragement and success, he continued to reside and practice there during the remainder of his life. Thus soon terminated a copartnery, perhaps unexampled in the annals of science, between two young men who both rose to the summit of professional eminence, though in different lines, in the two British capitals. Cullen and Hunter continued ever after to correspond on the most cordial terms of friendship; but it is believed they never afterwards met, though each of them lived to an advanced age.

Left by himself at Hamilton, Cullen soon rose above the ordinary estimation of a village practitioner, by the unembarrassed elegance of his manners, the kind and soothing attentions which he paid to his patients, and his superior, yet unassuming display of social talents and scientific acquirements. Soon after his removal to that town, the Duke of Hamilton, who occasionally resided in what is called the *Palace*, was taken suddenly ill, and young Cullen was called to visit him. In the course of his attendance, the Duke was much pleased with his professional assiduity and unexpected display of ingenious, sprightly, and instructive conversation. The disease with which the Duke was at this time afflicted, was of such a nature as to resist the effects of the first applications, and Dr Clerk, then a physician of great eminence at Edinburgh, was sent for. This circumstance, far from injuring the character of Cullen, tended greatly to his advantage; as Clerk expressed entire satisfaction with his previous treatment, and became his eulogist upon every occasion. Cullen never forgot this kindness; and when Clerk died, delivered a public oration in his praise in the University of Edinburgh.

Thus early introduced, almost by accident, to the notice of the two noblemen of highest rank and influence in the country at that time, and acquiring the esteem and favour of both, Cullen soon emerged from the humble sphere in which he had been hitherto placed, to move in a more brilliant circle, as a physician and professor successively, in the two principal cities and most celebrated universities of Scotland. While he continued to reside at Hamilton, and was still in early life, he married Miss Johnston, a young lady nearly of his own age, and the daughter of a neighbouring country clergyman. This lady is said to have been sensible, beautiful in her person, amiable in her disposition, elegant in her manners, and of uncommon equanimity of temper. She also brought a small fortune, which would at that time be no small help towards the establishment of a young man. After becoming the mother of a numerous family, and participating with her husband in the rise of character and fortune, which he so richly merited, Mrs Cullen died at an advanced age in the summer of 1786, not quite four years before the Doctor.

Cullen took the degree of Doctor of Medicine in the University of Glasgow, on the 4th September 1740; and, in 1746, when about 25 years of age, he was removed from being a country practitioner at Hamilton, to the more exalted situation of Lecturer in Chemistry in the University of Glasgow. In that university, as in some others, a lecturer gives lessons to the students exactly as a professor, but is not admitted into the corporate body, and has no participation in the funds, except in so far as a limited salary may be granted to him by the Senatus Academicus, with whom alone the management of them is entrusted.

Chemistry was then in a great measure a nascent art, hardly deserving the name of a science, but had escaped from the mystic trammels and wild reveries of the alchymists, and was beginning to put on somewhat of the garb of a department in physical science, in consequence of the ingenuity of Becker and Stahl, and the industry of Boerhaave. In teaching the almost unconnected and chaotic multitude of facts then belonging to chemistry, which were held together at that

Cullen. time by the theory of phlogiston, Dr Cullen displayed uncommon talents for distinct philosophical arrangement, for extraordinary vivacity and clearness of illustration, for eloquent language, and apt experiment. By these he rendered his lectures exceedingly interesting to his pupils, and soon acquired a popularity among the students far beyond what the other medical professors enjoyed—a circumstance which is said to have engendered no small degree of envy among them.

Besides acquiring fame in the discharge of his academical duties, Cullen rose rapidly in reputation and practice as a physician; and, in 1751, at the age of thirty, was appointed Regius Professor of Medicine. In this new situation he displayed the same qualities which had already distinguished him, and with the same success; and his celebrity, both as a professor and a physician, continued to increase.

In 1756, by the death of Dr Plummer, the chair of chemistry in the University of Edinburgh became vacant, and Cullen received an unanimous invitation from the Magistrates and Town Council of that city, to supply the vacancy, which he accordingly accepted. Till then the study of chemistry had been of small account in the University of Edinburgh, and the lectures on that science were attended by a very inconsiderable number of students. The scene was now entirely changed, and the new professor became so popular, that the chemical lectures were more numerously attended than any other in the university, those on anatomy excepted. To the students, Cullen presented a new and fascinating source of instruction, in the luminous arrangement which he adopted, the easy flowing eloquence with which he expressed himself, and the well devised experiments which he employed to illustrate his subject; and he is said to have been praised on all occasions by his pupils in such rapturous strains of eulogy, as to give much dissatisfaction to his less popular colleagues.

A party is said to have been formed at this time among the students for injuring his fame and character, by misrepresenting his doctrines; and so successful were they, that some even of the most intelligent professors in the university thought it their duty publicly to impugn the doctrines that were imputed to him, and some time elapsed before they discovered the low and scandalous arts by which they had been deceived. During this strange ferment, Cullen steadily continued his progress without taking the smallest notice of what was going on; nor did he ever listen to any tales respecting his colleagues, or advert to any of the doctrines they taught, considered personally as theirs, though he certainly opposed, and finally overturned the general medical theories which they had embraced, and which were then universally followed by the disciples of Boerhaave. These mean and unprincipled attempts to injure the reputation of Cullen, at his first appearance in the university of Edinburgh, completely failed, as the other professors were at length sensible that they had been misled and imposed upon by false representations; and that harmony which had thus been maliciously disturbed, was at length happily restored. Disputations, indeed, always carried on with keenness, and sometimes with singular acrimony, long prevailed among the students in their societies, respecting the contending doctrines; but these were confined to the students, and in the main tended much to their improvement, by urging them to study with increased energy, that they might make a better figure in the debate.

In February 1763, the professorship of Materia Medica and Pharmacy became vacant by the death of Dr Alston, in the middle of the session. The patrons of the university appointed Dr Cullen to the vacant chair, and requested him to finish the course of lectures of that season, already half elapsed. Although thus under the necessity of proceeding to teach this new branch of medical science only a few days after his nomination, he determined to deliver an entire new course of lectures of his own composition, instead of reading those already prepared by his predecessor; and such was the high estimation in which he was held by the students, that the original eight or ten who had entered to the course of his predecessor, were soon joined by above an hundred others, even at that advanced period of the course.

By the death of Dr Whytt, in 1766, the chair of the Institutes of Medicine, usually called the Theory of Physic, became vacant, and Cullen was appointed by the Magistrates to that professorship also. On this occasion, he resigned the chemical chair in favour of the celebrated Dr Black, formerly his pupil, and his successor as lecturer on chemistry in the university of Glasgow.

Either in the same year with the death of Dr Whytt, or in that immediately following, Dr Rutherford, who had long given lectures on the Practice of Medicine, with great reputation, resigned that chair, to which Dr John Gregory was elected, though we believe Dr Cullen was also a candidate. For two subsequent sessions of the university, Dr Gregory and Dr Cullen continued to lecture respectively on the Practice and Theory; but we have been informed, that, in summer 1769, Dr Cullen opened a private course of lectures on the Practice, and before the conclusion of that course, a compromise took place between him and Dr Gregory, in consequence of which they were elected joint professors of the Practice and Theory, each to give lectures in alternate sessions on these two branches during their joint lives, and the survivor to have the choice of either chair at the decease of the other.

This was a wise and most beneficial arrangement—advantageous at once to the individuals more immediately concerned, and to the seminary in which they laboured. Both professors possessed superior talents, and they happily co-operated to forward the pursuits of the medical students, and to extend the reputation of the university; which, by their great abilities and excellent methods of teaching, combined with the eminence of their other colleagues in the medical faculty, rose rapidly to very high and well-merited celebrity as a school of medicine, annually attracting great numbers of students from all parts of the British dominions and colonies, and many from foreign countries, by whom its fame was diffused through all the civilized parts of the globe.

A period, however, was soon put to this arrangement, by the sudden death of Dr Gregory, who was cut off in the flower of his age and usefulness, to the great loss of medical science, and to the infinite regret of a numerous circle of friends and admirers. From that period, Dr Cullen continued to give lectures on the Practice of Medicine, till within a few months of his death, which took place at Edinburgh on the 10th February 1790, at the advanced age of seventy-seven years and two months.

Besides the lectures on the Practice of Medicine, and the other courses he before delivered from the several chairs which he had successively occupied, with so much honour to himself and advantage to the students, he also long gave regular courses of what are called Clinical Lectures, alternating with the other professors of the medical faculty. These are delivered on the actual cases of patients attended by the clinical professor of the season, accompanied by the pupils, in wards of the Royal Infirmary set apart for this purpose: an institution of most admirable utility, by which the medical students are initiated into all the minutiæ of real practice, and habituated to reason judiciously on the nature, symptoms, and diagnostics of diseases, and on the qualities, operation, and effects of remedies employed for curing them; instead of blindly following empyrical modes of prescription, merely because such and such nostrums have been recommended for such and such diseases.

As a philosopher and as a lecturer on various branches of medical science, the mind of Dr Cullen was not so much occupied in minutely examining the separate parts of the subjects on which his attentions were engaged, as in tracing the various relations, connexions, and dependencies, by which they constitute individual portions of one harmonious whole; and his singular talent for arranging, in lucid order, the numerous subjects on which he treated, joined to the easy, perspicuous, and flowing language in which he communicated his ideas, particularly distinguished him as a public lecturer. This faculty, however, could not, by itself, have merited the high applause which he so justly obtained. An accurate and extensive acquaintance with facts was necessary to give it its full exercise. His whole life, accordingly, was industriously and almost uninterruptedly employed in the collection of facts, by reading, by conversation, and by diligent observation in the course of discharging his professional duties, both public and private. These he marked with uncommon keenness of perception, as they occurred, without stopping at the time to record, or even to examine them in their several bearings; but he stored them up in his memory, for being afterwards brought forwards as occasion might require, to be then sifted, examined, and compared, in all their relations and connections, and applied as proofs and illustrations of the subjects to which they severally had reference.

All his prelections were delivered extempore, without having been previously committed to writing, and were only assisted by a few short notes or heads of discourse, merely to preserve the accustomed order of his general arrangement. This free and unconstrained manner of enunciation, gave to his lectures an appearance of ease, vivacity, and force, that is rarely found in academical discourses; so that they were never precisely the same, even upon the same subjects, in different seasons, but always presented something novel, at least in their language and illustrations. His mode of delivery was eloquent and energetic, and at the same time easy, flowing, and natural, on which account his lectures never failed to captivate his hearers, and command their unremitting attention. Even such of them as were unable to follow him in those profound views which he frequently presented, or could not fully comprehend the apt allusions to collateral subjects, at which he often hinted only as it were in passing, were yet unavoidably warmed in some measure by the vivacity of his manner. Those of his pupils, on the other hand, who were able to keep pace with him in his rapid career, found every faculty of their minds roused to action by the extensive views which he opened up to them, and were excited to such ardour of admiration and of study, as seemed incomprehensible to mere unconcerned spectators.

His influence upon young minds was much augmented by the captivating novelty of his speculative or theoretic opinions, and by the freedom with which he animadverted upon the medical systems that were chiefly in vogue at the commencement of his academical career, and which certainly afforded legitimate points of attack. At that period, the medical school of Edinburgh, closely following that of Leyden, was fast bound in the trammels of the Boerhaavian humoral pathology, which attempted to explain the nature of diseases, and to found the rationale of their cure upon a suppositi-tious leutor viscidity and acrimony of the fluids. Even in his first clinical lectures, before he became professor of the institutes of medicine, Dr Cullen bent the main strength of his pathological arguments to combat this doctrine. He succeeded in his attempt, having soon shaken its credit, and at last most completely overturned it. It is not meant to give any view, in this place, of the doctrine which he then endeavoured to substitute in the place of the one that he had exploded, and the establishment of which he afterwards effected, but it may be noticed, very generally, that he adopted and expanded the pathological opinions already advanced by Hoffman; according to which, the nature of disease was more rationally explained, by considering the errors induced, by their remote, occasional, and proximate causes, upon the actions of the living solids or vital motions, than by any supposeable vitiated condition of the fluids or humours, of which there is no evidence from fact and observation. *Ex vitio motuum microcosmicorum in solidis, potius quam ex variis affectionibus vitiosorum humorum.*

It cannot be asserted, however, that the doctrine of *Spasm and Atony* was much better founded in reason and observation than that of *Leutor Viscidity and Acrimony,* which it so completely superseded. But Dr Cullen certainly succeeded in setting free the minds of the students from the shackles of long established and uncontrouled authority, always injurious to the advancement of science, and taught them to think for themselves, by comparing reasonings and inductions with facts and observation. He thus introduced new and extensive views and speculations among the students, which, if not always satisfactory, were always ingenious, and afforded them excellent topics for discussion in their various societies. At an advanced period of Dr Cullen's life, such was the enthusiasm excited among the students on certain points of controversy arising out of his hypothesis, contrasted with another set up in opposition to it by a private lecturer, that several duels were fought in consequence; and it has been alleged, that Dr Cullen began at length to feel some of that jealousy towards a rival innovator, which he himself had inspired at the commencement of his own career. But it would extend our sketch to a most inconvenient length to attempt any elucidation of this medical controversy. Suffice it to say, that the Brunonian doctrine was in a great measure a modification of the Cullenian *Spasm and Atony,* disguised under new terms, and arranging all diseases under the heads of *Sthenic and Asthenic.* See the Life of Brown in this Work.

While the uncommon popularity which Dr Cullen enjoyed was chiefly owing to his great merit as a teacher, it was also much forwarded by the laudable pains he took to ingratiate himself with his pupils. He was cordially attentive to all their interests, invited them frequently to evening parties at his house, conversed with them upon the most familiar terms, endeavoured to solve all their doubts and difficulties, gave them the use of his extensive medical library, and treated them in every respect with the kindness of a friend, and the affection of a parent. In their sickness, he attended upon them as their physician, and uniformly refused to accept of any fees,—a species of generosity which had not been customary in Edinburgh before his time.

The high, and even enthusiastic favour in which he was held by the students to the very last, was strongly evinced by the many eulogies upon his character, to be found liberally interspersed among the numerous inaugural dissertations of his pupils, and by the affectionate addresses presented to him by the Royal Medical and Physical Societies upon his resignation of the practical chair in the university, a few months before his death.

No chemical discoveries of any moment have been attributed to Dr Cullen; but he was a most useful and successful teacher of the science, so far as it had then advanced, in consequence of the liberal and comprehensive views which he took of its facts and doctrines, and the admirable arrangement in which he presented these to his pupils. He also gave very complete histories of several of its departments, by an accurate collection and clear distribution of facts,—particularly of such facts as are connected with medicine and pharmacy. His only publication on the subject, was a small pamphlet, containing an account of some experiments on heat.

His lectures on materia medica, though necessarily put together in great haste, were so much admired, that copies of them, taken from notes, were multiplied among the students; and at length one of these copies was surreptitiously put to press in 1772. Dr Cullen at first obtained an interdict against this imperfect and piratical publication; but having undergone some corrections, it was afterwards allowed to proceed. He promised, at the time, to give an improved edition of the work, which he accordingly published in 1789, in two volumes quarto. This edition, though certainly more full, and perhaps more instructive than the former, greatly wants those fascinating and systematic general views of the subject by which it was recommended, and which the author perhaps endeavoured too much to alter or modify. Its inferiority may also have been in part occasioned by the energy of his mind beginning to decay, at his then advanced period of life. This work, however, materially differs from the ordinary systematic performances on the subject, and is in a great measure the philosophy of the materia medica, rather than a dry matter-of-fact history of its various topics. It is arranged according to the medical indications, and contains admirable introductory observations on each class, forming an excellent system of Therapeutics. Many also of the general doctrines in the practice of medicine are introduced, and these are even illustrated in some detail.

The character of Dr Cullen as a teacher of the theory and practice of medicine, is now only to be estimated from the works he published as text-books for his lectures.

While professor of the theory or institutes of medicine, he published a short text-book on that subject, but it was never completed or moulded into a regular treatise, and still remains in its original form, merely intimating the heads of his lectures in that department. The other, which was designed to be a text-book for the course of the practice, was entitled *First Lines of the Practice of Physic*. Of this, various editions appeared successively, enlarged and altered as his views expanded in the progress of his professional labours. The complete edition, not afterwards changed, appeared in 1784, in four volumes octavo. In this work, regarding the actions of the moving powers in the animal economy, as the leading principles of inquiry, in considering the diseases of the human body, he assumed, as formerly mentioned, the general doctrines previously advanced by Hoffman on this subject, but considerably corrected and extended. In the application of these to the consideration and explanation of the symptoms and nature of disease, he disclaims the adoption of what are usually termed hypothetical notions or theories, asserting that the doctrines he endeavours to establish are just inductions or generalizations from observed facts, in relation to the healthy and diseased states of the body; and he certainly has shewn himself a very faithful collector of facts, to which he allows all due weight in the course of his reasonings. He was not satisfied, however, with a mere empirical basis for medical practice, but always endeavoured to investigate the proximate cause of disease, or, in other words, the intimate nature of the diseased action, on which to ground a rational method of cure, fitted to restore that action from its vitiated to its natural and healthy state. The most remarkable of his attempts of this kind, is his doctrine respecting the proximate cause of fever, in which he endeavours to establish the coexistence of spasm and atony in the human body. However subtle the reasonings may be deemed, on which this and others of his opinions are founded, his work certainly possesses great merit in the excellent descriptions and sagacious discriminations which it contains, and in the full and commonly just views of practice which it displays and inculcates. For, though grounded upon all the refinements of speculation, it yet shews that he paid so much respect to experience, as to submit to its decisions on all points of practice, even at the risk of appearing occasionally to contradict his own speculative doctrines.

Another class-book is his *Synopsis Nosologiæ Methodicæ*, of which the third and complete edition appeared in 1782. This contains abstracts of the systematic nosologies of Sauvages, Linnæus, Vagel, and Sagar, as introductory to a new arrangement of his own, intended as an improvement upon all the others; and he has certainly succeeded in the task, as far perhaps as the nature of the subject could admit. The *First Lines of the Practice of Physic*, and the *Synopsis Nosologiæ Methodicæ*, still remain standard books, and are still perhaps unrivalled. A pamphlet, published in 1775, *Concerning the Recovery of Persons drowned, and seemingly dead*, written and published, we believe, at the request of the Scots Board of Police, completes the list of his works, so far as we have been able to learn.

The person of Dr Cullen,—we speak of him only in his advanced years,—though striking, and not unpleasing, was by no means elegant. His countenance was expressive, and his eye was remarkably lively and penetrating. His figure was tall and thin, and he had a remarkable stoop about the shoulders. In walking, he had a contemplative look, and did not seem much to notice the objects around him; but in conversation he was animated, attentive, polite, and instructive in an uncommon degree.

Though generally occupied, during five or six hours, almost every day, in visiting patients, or in dictating prescriptions and directions for those who consulted him by letter from a distance, besides having to deliver two public lectures of an hour each, five days of the week for nearly six months every year, sometimes four lectures daily for a considerable period towards the close of the session, that he might complete his courses; yet, whether in public or in private, Dr Cullen never appeared embarrassed or in a hurry, but was always collected and at ease, devoting himself entirely to the present subject, as if he had nothing else to occupy his attention. He was always sociable and cheerful, and ever ready to enter upon the serious subject of the hour, or to discuss the ordinary occurrences of the day. At night, when the labours of the day were over, he enjoyed a private party at whist, for sixpence a corner, even in his latter years, with as keen a relish as if he had no serious employments to think of; and no man more delighted in, or contributed towards, the temperate hilarity, and rational yet amusing conversation of a social supper-party, in which he frequently indulged.

Such is the imperfect view we have been able to collect, of the life and character of a first-rate luminary of the university of Edinburgh, for which we are chiefly indebted to *Hints and Anecdotes relating to his Life*, published by the late James Anderson, LL. D. in a periodical work entitled *The Bee*, about ten months after the death of Dr Cullen. We have been informed, that a more extensive memorial of his life was prepared, many years ago, by a respectable member of the university of Edinburgh, well qualified to do justice to the subject, and was intended to have been published; but, having been communicated for revisal and correction to another person, who was more especially able to supply dates and family circumstances, it was never returned to the author. (KK)

CULLODEN, Battle of. This battle, memorable for being the last fought on British ground, and highly important in its consequences to the peace and security of these kingdoms, happened on the 16th of April 1746, on a moor, about a mile and a half south from Culloden House, and nearly five miles south-east from Inverness.

The success of Charles since his first landing, though occasionally obstructed by dissensions among his friends, had hitherto been extremely flattering to his hopes. Arriving in Scotland with only seven followers, his little army rapidly increased as it advanced; and in a short time became so formidable by its numbers, as to inspire terror into the commander of the king's troops, who, instead of attacking him at Corryarak, as he intended, marched northwards to Inverness, and thus left the low country open to his incursions. Accordingly, Charles now abandoning the fastnesses of Lochaber, advanced into the centre of the country, entered Perth, and proclaimed his father king. From Perth he proceeded to Edinburgh, which he also entered without opposition, and repeated the same ceremony. Meantime, Sir John Cope, finding it dangerous to return from Inverness by the Highland road, on account of the approach of winter, marched his troops along the coast to Aberdeen, and from thence conveyed them by sea to Dunbar. On hearing of their approach to the capital, Charles advanced to meet them, and defeated them with considerable loss in a pitched battle near Prestonpans. In consequence of this victory, he was joined by a few of the Scottish nobility, at his return to Edinburgh; from which place, after some delay, occasioned by a fruitless correspondence with the northern chieftains, he proceeded southwards, making an irruption into England, and spreading alarm and devastation almost to the gates of the capital.

But being now threatened on all sides by the royal army, and harassed by the importunities of his followers, he was compelled to retrace his steps, without effecting any thing. Though pursued by the king's forces, he reached Carlisle, without once coming in contact with them, except at the village of Clifton. After reinforcing the garrison of Carlisle, he entered Scotland by Dumfries, and proceeded to Glasgow, and from thence to Stirling. The garrison of this place refusing to submit, afforded him an opportunity of gathering a few more useless laurels; for Hawley, the commander of the king's troops at Edinburgh, advancing westward with the view of relieving the place, was met by Charles near Falkirk, and defeated with great slaughter. But this was the last of his triumphs; for, immediately after, the Duke of Cumberland assumed the command. Having collected the scattered remains of the battle of Falkirk, and joined to them some regiments lately arrived from the Continent, he instantly set out to meet the rebels, and offered them battle, on the very spot where they had so recently triumphed. By the advice of his generals, though contrary to his own inclination, Charles declined the offer, and retreated immediately with great precipitation to Crieff. Here he separated his troops into three divisions; one, commanded by himself, proceeded north to Inverness by the Highland road; another, under Lord George Murray, marched by the coast road; the third division, which was the smallest, took a middle road, by Braemar, which led them to their own country. The Duke followed them for some time; but, after arriving at Perth, he halted there a few days, both with the view of allowing the reinforcements which had lately arrived from the continent to join him, and in order that he might have an opportunity of consulting with the friends of government at Edinburgh respecting the best mode of terminating the war.

He set out from Perth on the 20th of February 1746, and, following the coast road, reached Aberdeen on the 27th of the same month. As the state of the weather prevented him from advancing farther at this time in pursuit of the rebels, he merely sent onwards a few detachments to occupy certain posts to the westward, which might afterwards facilitate his progress, and continued during the month of March with the great body of his army in the neighbourhood of Aberdeen. During this period of inaction on the part of the king's troops, the rebels were busily employed. They had got possession of Fort George and Fort Augustus, and were actively employed in the siege of Fort William. They had defeated Lord Loudon in Sutherland, and had compelled him and President Forbes to take refuge in Skye. They had surprised a number of posts occupied by the king's troops in Athol; and had even cut off a detachment of the Duke's army which was stationed in the village of Keith. But the season now beginning to open, they were compelled to call in their scattered forces, and to prepare to meet the Duke of Cumberland, who left Aberdeen on the 8th of April, and advanced westward to the Spey, without encountering the least opposition.

When the royal army came in sight of the river, they discovered the Duke of Perth on the opposite bank with a considerable force, and seemingly prepared to resist their passage. Upon observing this, the Duke of Cumberland, for greater security, and for better effectuating his purpose, immediately formed his army into three divisions, and crossed the river at three places, about half a mile distant from each other. The Duke of Perth, however, without waiting to oppose any of the divisions, upon seeing the king's troops approach the river, instantly drew off his men, in obedience to private instructions, and retreated westward to join Charles in the neighbourhood of Inverness. The main body of the royalists followed them leisurely; but some companies of grenadiers, with some light horse, and a few Argyleshiremen, who were more active in the pursuit, overtook their rear before it had quitted the town of Nairn, and a slight skirmish ensued. The rebels, however, still continued their retreat, closely followed by this detachment of the king's troops, and were upon the point of having a more serious rencounter with them at a place called the Loch of Clans, about five miles west from Nairn, when Charles unexpectedly arrived with some troops to their assistance; upon which the pursuers were in their turn compelled to retreat, and join the main body of their army, which encamped the same evening on a plain to the west of Nairn. It appears that Charles, upon receiving intelligence of the near approach of the Duke of Cumberland, had that morning left Inverness with part of his troops, and had ordered the rest to follow him to Culloden-moor, where he intended to offer battle to his enemies.

This resolution of the young prince must appear altogether rash and unaccountable, whether we consider the state of his army, weakened by the absence of numerous detachments employed in the service formerly alluded to; or the situation of the place, which was drawing him away from his resources; or the nature of the ground, which is peculiarly favourable for the operations of regular troops; or, above all, the happy opportunity which he had already deliberately lost, of opposing them at the passage of a rapid river. But whatever might be his motives, certain it is, that next morning he drew out his forces on Culloden-moor, in the expectation that the Duke of Cumberland would leave Nairn that day to meet him. After waiting till past noon, and no enemy appearing, it occurred to him that the royal army might be engaged in celebrating the Duke's birth-day, and consequently would not begin their march till the following morning. He accordingly ordered the men to quarters, and instantly summoned a council of his officers. At this meeting, after considerable difference of opinion, it was determined to make a night-attack upon the Duke's camp at Nairn.

This scheme, which in its details was extremely plausible, seemed to be still more advisable from a consideration of the temporary relaxation of discipline, which, it was probable, would exist in the king's army in consequence of the festivity of the preceding day. This plan, however, so specious in itself, and so opportunely devised, failed completely in the execution, and placed the rebels in far worse circumstances than they were previous to the attempt.

This failure was partly owing to that general insubordination common to all irregular troops, and which had always prevailed to a great extent in the rebel army, but which was, on the present occasion, greatly increased by the hardships which they suffered from want of pay, and regular supplies of every kind; partly to the length of the march, and the short time which could be allowed for performing it; and partly to the extreme darkness of the night, and the necessity they were under of leaving the common road, in order to avoid the houses which lay in their way. The result of all which was a considerable loss of time in commencing the march, and a still greater difficulty in getting on, after the line was put in motion, occasioned by the weakness of some, the desertion of others, the badness of the roads, and the want of unanimity among the chiefs themselves, respecting the expediency of the measure itself. In such circumstances, failure was quite inevitable. While they were yet three miles from Nairn, two o'clock, the hour of the proposed attack, was past. The near approach of dawn, and the beating of a drum in the enemy's camp, now convinced the most sanguine that the project ought to be abandoned, or, at least, that surprise was impossible. Nothing remained, therefore, but to retreat to Culloden; which they did without the least molestation on the part of the enemy, and in much shorter time than they advanced.

Whether this scheme of a night attack would have ultimately succeeded, even if these obvious causes of failure had not occurred, is extremely doubtful; for we find, that the Duke of Cumberland, though ignorant of the details of the plan, especially of that part of it which consisted in attacking him on the south side, was completely informed, by means of spies, of the approach of the rebels, and had made preparations accordingly. Upon hearing, therefore, of their retreat, he drew out his army at break of day, and advanced westward in pursuit of them. The rebels, oppressed with hunger and fatigue, had reached Culloden nearly about the time the Duke began to move from Nairn. But so distressful was their condition, and so overpowering the calls of nature, that, in spite of their perilous situation with regard to the enemy, they no sooner arrived at their former ground, than they immediately dispersed in different directions,—some fainting with fatigue, lay down on the heath to rest themselves, others betook themselves to the woods, others to the villages around in quest of food, and some went even so far as Inverness for the same purpose. While his troops were in this state of disorder and inefficiency, news was brought to Charles at Culloden-house, that the Duke's army was in full march towards him. There seemed to be now no alternative but to fight, even in his present unfavourable circumstances, or to give up the cause as lost. Charles chose the former. Having rallied his troops in the best manner possible, he drew them up on the moor, about a mile and a half south from Culloden-house. The arrangements for battle were made by Sullivan, quarter-master-general, in the following order: He formed the whole, with the exception of a small body of reserve, into two lines; the first consisting of eleven, and the second of nine regiments. The Athol regiment occupied the right of the first line; and on their left, in regular succession, were formed the Camerons, the Appins, the Frasers, the Macintoshes, the united regiment of Maclauchlans and Macleans, Roy Stewart's regiment, Farquharson's, and the three Macdonald regiments, viz. Clanranald, Keppoch, and Glengary. The second line was composed of the following regiments, viz. two battalions of Lord Ogilvie's regiment on the right; and to their left, two battalions of Lord Lewis Gordon's regiment, two battalions of Glenbuckets, the Duke of Perth's regiment, Lord John Drummond's regiment, and two regiments of Irish piquets. The reserve consisted of Lord Kilmarnoch's regiment of foot guards, and the remains of Lord Pitsligo's and Lord Strathallan's horse. On the right of the first line was a troop of horse guards; and on the left of the second line a troop of Fitz-James' horse. The cannon was placed in the centre and on the flanks of the first line. Lord George Murray commanded the right, and Lord John Drummond the left, of the first line. The command of the second line was entrusted to General Stapleton. Charles stationed himself on a small eminence behind the right of the second line.

The spot selected for the engagement was remarkably well chosen, being as favourable to the rebels as the nature of the ground would admit. Immediately south from them was a square enclosure of stone, which extended to the banks of the Nairn, the northern wall of which covered their right flank. In their front the moor was uncommonly marshy and soft; and on their left, though at considerable distance, were the woods of Culloden-house.

In this condition were the rebels when the royal army came in sight, about mid-day. The Duke of Cumberland, upon seeing them drawn up in battle array, commanded his troops to halt, and formed them upon a plan similar to that of the enemy. His first line consisted of six regiments, in the following order, viz. the Royals on the right; on their left Chomondley's regiment, Price's, the Scots Fusileers, Munro's, and Burrel's. The second line consisted also of six regiments, viz. Howard's, Fleming's, Ligonier's, Blyth's, Sempil's, and Wolfe's. Blakeney's, Battereau's, and Pulteney's composed the reserve. On the right of the first line were stationed the Duke of Kingston's regiment of light horse, and a squadron of Lord Cobham's dragoons; and on the left, Lord Kerr's regiment of dragoons, and two squadrons of Lord Cobham's horse. Two pieces of cannon were placed between each battalion in the first line; and three pieces between the first and second battalions on the right and left of the second line. This line was drawn up in such a manner, that the centre of each regiment was opposed to the interval between the regiments in the front line. The Earl of Albemarle commanded the first line, Major-General Huskison the second, and Brigadier Mordaunt the reserve. The Duke of Cumberland placed himself between the first and second line, in the front of Howard's regiment.

When the two armies came in sight of each other, they were about three miles distant. The king's troops, however, after making the necessary arrangements, immediately advanced towards the enemy, and when the front lines approached within 500 or 600 paces of each other, a smart cannonade commenced on both sides. The wet ground in front of the rebels, formerly alluded to, now proved extremely harassing to the royal army. Their heavy cannon sunk into the soft mossy soil, and several regiments, especially Wolfe's, which occupied the left of the second line, were standing above the ancles in water. To remedy this inconvenience, the whole line made a movement in advance, till it reached firmer ground; and as the moor on the left of the second line still continued marshy, Wolfe's regiment was ordered to form on the left of the first line, and to front to the north, by which means it was prepared to fire upon the flank of the rebels if they advanced from their present position. While this movement was making on the left of the line, the Duke of Cumberland observing that the left wing of the rebels stretched considerably beyond his right, ordered two regiments from the reserve to advance and form upon the right of each line, viz. Pulteney's on the right of the Royals, and Battereau's on the right of Howard's.

These arrangements being completed, the cannonade, which had never ceased on the part of the rebels, was renewed by the royal army with increased activity and dreadful effect. Every where in the opposite ranks were seen the destructive ravages of the royal artillery; while the cannon of the rebels, being ill-directed and ill-served, made no impression on the king's troops. The Duke observing this, ordered the cannonade to be continued, in the expectation of compelling the rebels to advance to the attack, by which means they would lose their present advantageous position, and expose their right flank to a destructive fire from Wolfe's regiment. His expectation was soon realized. The Macintoshes, unable any longer to support the galling fire of the artillery, broke from the centre of the first line, and advanced against the regiment opposite them. They were followed by the four regiments to their right, and the Maclauchlans and Macleans on their left. The Macintoshes, who were a little in advance, having met with a heavy fire of musketry from the Scots fusileers, which were opposed to them, immediately inclined to the right, which caused the whole right wing of the rebels to come down upon Burrel's and Munro's regiments. These regiments, however, continued firm, and received them with a very heavy fire of musketry, and cannon loaded with grape-shot.

In spite of this warm reception in front, and a still more destructive fire from Wolfe's regiment on their flank, the rebels continued to advance, and rushing forward sword in hand, cut their way through the opposing ranks, and pushed on to the second line. Sempil's regiment, which occupied the left of this line, was now destined to support the impetuous shock of the whole right wing of the rebels. Nor were they unequal to the difficult task imposed upon them. During the attack they had advanced a few paces from the second line, and upon seeing the rebels break through the first line, they prepared to receive them with their front rank kneeling and presenting. The remains of Burrel's and Monro's regiments retired behind the battalions on their right, and the rebels, after closing their ranks, rushed forward with more than their usual impetuosity. Sempil's regiment, however, remaining calm and unmoved, allowed the rebels to approach within a few paces of their front rank; and when they had almost reached the points of their bayonets, they opened upon them a dreadful fire, which brought the greater number to the ground, and caused the remainder to fall back. A few, desperate and furious, still pressed on and made a fruitless attempt to break through the lines opposed to them, but were received on the bayonets of the front rank.

The regiments on the left wing of the rebels did not advance at the same time, or charge with the same impetuosity as those on the right. Having gradually approached the king's troops, and sustained a regular fire without shrinking, they gave a general discharge, and having drawn their swords, were prepared to rush forward after their usual manner. But upon observing the fatal result of the attack on the right, they immediately wheeled about, and retired upon their second line. The cavalry on the right of the king's army, seeing the rebels face about, instantly began the pursuit: but the Irish piquets opportunely advancing, soon caused them to halt, and allowed the fugitives to fall back on the second line. The two lines being now joined, formed a considerable body of men; but their hearts were broken, and their condition altogether hopeless and irretrievable. The Duke of Cumberland, after closing his ranks, advanced upon them with a firm step, and with all the confidence which recent success inspires. The cavalry on the wings of the royal army were eager to pour in upon them. The wall which guarded their right flank was broken down, by which means a body of horse had got in their rear. There was no time for deliberation; no alternative left but to seek safety in flight, or to rush upon certain death. They preferred the former. At first they went off in small parties of four and five. Afterwards the whole separated into two large bodies, one of which directed its course towards Badenoch, and the other to Inverness. The route being now general, orders were issued to pursue, and as there was little disposition in the king's troops to give quarter, the carnage which followed was dreadful. The number of the slain on the part of the rebels has never been accurately ascertained; some rating it at two, and others at three thousand. Most of the chiefs who commanded the regiments on the right wing which made the furious charge were killed, and almost every man in the front rank of each regiment. Charles himself very narrowly escaped from the field of battle; and after wandering for several months among the wilds in the west of Scotland, he was fortunate enough to make good his retreat into France.

The loss on the part of the victors was comparatively trifling, being not more than 300; and no person of distinction fell, except Lord Robert Kerr, second son of the Marquis of Lothian and captain of the grenadiers in Burrel's regiment.

Such was the fatal conclusion of an enterprise which, from its fortunate commencement, promised a very different issue. What would have been the result upon the happiness and prosperity of these realms if Charles had succeeded in recovering the throne of his grandfather, is not for us to determine. The opinions of men on this subject will differ, according to their prejudices, partialities, or political views. It is sufficient for us to know, that whatever might have been the change, it could have contributed little to the power, the wealth, the liberty, and political importance of these kingdoms. (*s*)

CULM, or KULM, a town of Poland, in the Grand Duchy of Warsaw, is situated upon a rising ground on the banks of the Vistula. The town is large, though by no means populous, and has a Catholic college, and five Catholic convents. It was formerly one of the Hanseatic towns, and the extent of its trade was indicated by large warehouses, which were erected by English merchants. Early in the 14th century, its commerce was in a great degree transferred to Dantzic; and though it has since revived at particular periods, yet it has always been annihilated by the different wars with which Poland has been agitated. Culm received from the Teutonic order the privilege of coining money; and after it fell into the possession of Prussia, a military academy for 60 young noblemen was established in the town. At the peace of Tilsit, in 1807, it was transferred to the kingdom of Saxony; but in consequence of the recent conquest of Poland by the Russians, it will probably fall to the lot of some other prince. (*j*)

CULROSS, a royal burgh in Scotland, situated upon the north bank of the river Forth, about 18 miles above Leith, and in that detached part of Perthshire which lies betwixt the shires of Clackmannan and Fife. The name is of Gaelic origin, viz. *Cul*, back, and *Ross*, a peninsula: The whole district of country between the rivers Forth and Tay, formerly went under the name of Ross. This town, though small and irregular, is beautiful in point of situation; one street extends along the shore, and another runs in an oblique direction along a very steep bank, which is wholly laid out in gardens, with fruit trees. At the top of this street are the ruins of the Cistercian Abbey or Monastery, founded in 1217, by Malcolm, Thane of Fife, and immediately adjoining are the remains of the abbey church, dedicated to the Virgin Mary, and to St Serf, who was the tutelar saint of Culross; the first day of July was annually kept as a festival to his memory. Amongst many of the ceremonies performed on that day, the inhabitants rose very early in the morning, and walked in regular procession, carrying large green boughs, accompanied with music. It is somewhat singular that this ceremony is still kept up, though the particular day is changed, and the origin of it entirely forgotten. Part of the abbey church is used as the parish church, and its lofty massive square towers, finished with a keep at the top, is still very entire. In the convent were nine monks of the Cistercian order, and a confessor. Upon the shore, at the east end of the town, there could be traced, till within these few years, the ruins of a chapel, which was known by the name of St Mungo's Chapel; and upon the shore west from the town, is the scite of Dunnemarle Castle, said to have been a strong hold of the Macduffs, Thanes of Fife. Upon the verge of their western boundary, in this castle, according to tradition, Lady Macduff and her children were murdered by order of Macbeth.

Adjoining the abbey church, stands the once magnificent house built by Edward Lord (Bruse) Bruce, anno 1590; from its situation it commands a most extensive, rich, and varied prospect, with the river Forth in the immediate foreground, having all the appearance of a great lake.

This town is now very much upon the decline, many of the houses being uninhabited, and going to ruin. In former times, however, it was a place of considerable trade, having collieries upon the most extensive scale, and carried on with great enterprise and spirit. One of the pits was in the sea, about a mile from the shore, surrounded with a moat of strong mason-work, where the coals were put on board the ships. The water of this pit was drained from the mine by machinery placed on the shore. When King James VI. visited these coal works, he went down a pit upon the shore, from the bottom of which he was conducted to the pit within the sea; when he ascended it, and saw himself surrounded with water, he instantly conceived that there was a plot against his life, and cried out treason: From this apprehension, however, he was soon relieved by his host and guide, Sir George Bruce, who had in readiness an elegant boat to conduct him to the shore. Several years after this, a violent storm destroyed these singular works, and they were never repaired. Previous to this disaster, great quantities of coal were shipped at these collieries for the coasting trade, London, and the Continent. By an act of Parliament, 1663, the Culross chalder of coals was established as the standard coal measure for Scotland. Here, also, the making of salt from the river Forth was at this period carried on to a great extent, there being at least 50 salt pans employed in the manufacture. This town had also the exclusive privilege of making girdles of beat iron, used in Scotland for baking cakes over the fire; about forty girdle-smiths were employed in this manufacture for the supply of Scotland; they had two royal grants of exclusive privilege, the one from King James VI. the other from King Charles II. But the Court of Session, in the year 1727, set aside the monopoly, after which the trade gradually declined, and it is now extinct.

Lord Dundonald, so justly celebrated for his extensive and practical knowledge in chemistry, resided long in the mansion-house at the abbey, which, with the estate adjoining, were his paternal inheritance: He endeavoured to revive the collieries, but met with insurmountable difficulties, to the great prejudice of his fortune: Here he invented and put in practice, upon a large scale, the process of extracting tar from pit coal, while the coal was converted into excellent coak for the manufacture of iron; the many other important discoveries in chemistry made by his Lordship, are well known to the world. We regret to think, however, that these discoveries have been of no advantage to himself in point of fortune, while many of them have been highly beneficial to the public.

All the collieries and works at Culross being entirely laid aside, have quickly accelerated the ruin of the place, and there is now but very little chance of seeing it revive.

Edward Lord Bruce, who built the mansion-house named the Abbey, fell in the fierce and noted duel fought betwixt him and Sir Edward Sackville, in Holland, where they agreed to meet. Lord Bruce requested, that if he fell in the contest, his heart might be sent home, and laid in his tomb in the abbey church. This tomb was opened lately, and there was found a leaden box which inclosed a large silver heart, within which was the heart of Lord Bruce preserved in spirits. The family arms, the words *Edward Lord Bruce*, and a leafless tree, with the appearance of clouds, were engraved on the silver heart, and perfectly distinct. The whole was carefully replaced, and entombed as they originally were.

Culross was erected into a royal burgh in 1588, by King James VI.; and in conjunction with Stirling, Dunfermline, Inverkeithing, and South Queensferry, sends a representative to Parliament, The population of the town and parish is about 1300. West Long. 3° 34′. North Lat. 56° 8′. (R. B.)

CUMÆ, Cuma, or Cyme, is the name of an ancient city of Italy, in the Campagna. It was situated on a lofty rock near the sea, and was founded by a Grecian colony from Chalcis in Eubœa, and from Cumæ in Æolia. Its power and population gradually increased, and Puteoli, and afterwards Naples, owed their origin to the enterprize of the Cumæans. Its favourable situation for commerce, and the fame of its oracle, its sibyl, and its temples, attracted votaries from every quarter. Cumæ, however, at length yielded to the power of the Romans, and from that time it seems to have gradually declined. The more beautiful and healthy coasts of Baiæ, Puteoli, and Naples, attracted from Cumæ its numerous visitors; and so rapid was its decline, that in the sixth century it was reduced to a military position, containing merely a fortress, situated upon a rock. In the 13th century, it became the head-quarters of banditti, and the neighbouring cities found it necessary to complete its destruction. The scite of the ancient Cumæ is now covered with a solitary wood, which is a royal chace, inhabited by stags and wild boars. A range of broad smooth stones here and there, and a few mouldering walls, overgrown with myrtles and vines, are the only vestiges of this great city. The following interesting account of the grotto of the sibyl, is taken from the classical tour of Mr Eustace, the most recent traveller in Italy. It is too interesting to be given in any other words but his own:

"Continuing," says Mr Eustace, "to advance towards the sea, we come to a high craggy rock near the shore. On the top of a precipice stands the castle, erected in the middle ages, on the ruins of an ancient fortress. In the side of this rock are two great chasms; in one, there are several steps leading upwards; the other, which leads downwards, was formerly lined with brick, and seems to have opened into several galleries. This cavern is now called the *Grotto of Sibyl*, and is probably part of that celebrated cavern. The grotto existed in all its splendour in the year 105 of the Christian era, and is described by Justin the Martyr, an author of that period, and represented by him as an immense cavity, cut out of the solid rock, large as a basilica, highly polished, and adorned with a recess or sanctuary, in which the sibyl, seated on a lofty tribunal or throne, uttered her oracles. It may have been stripped of its ornaments, disfigured, and perhaps materially damaged in the reign of Constantine, when the greater temples, and more peculiar seats of Pagan superstition, were demolished as objects likely to encourage and foster the ancient delusions. However, though despoiled and neglected, the cavern still remained entire, till the fatal and most destructive war carried on by Justinian against the Goths; when Narses, the imperial general, in order to undermine the ramparts of the fortress erected on the summit of the rock, ordered his engineers to work through the roof of the cavern beneath, and thus brought down the wall, towers, and even gates of the fortress, into the cavity, which in part destroyed, and in part filled it with rubbish. The grotto, as I have already observed, branched out into various subterranean galleries, alluded to by Virgil under the appellation of *approaches* and *portals*, which furnished the sibyl with the means of forming those tremendous sounds that in the moment of inspiration issued from the depths of the cavern. Of these communications, two only are now visible; all the others, with the body and recesses or sanctuary of the temple, are filled with ruins of the roof, the lining, and the walls." Mr Eustace is of opinion, that very interesting dicoveries might be made in this quarter by excavating the ground; and that from the advantage of sea carriage, the very materials would be sufficient to defray the expence. See Keysler's *Travels through Germany*, &c. vol. iii. p. 142, 143, 3d edition; and Eustace's *Classical Tour through Italy*, vol. i. p. 354—357. Lond. 1813. (π)

CUMANA, Nueva Andalucia, New Andalusia, is one of the governments which form the captain-generalship of the Caraccas. This government is bounded by the sea on the north; by the river Unara on the west; by the Orinoco on the south, excepting those parts where the left bank of that river is inhabited; and in this undefined part of its frontier, the jurisdiction of the governor of Spanish Guiana extends to within cannon shot of the establishments on the north of the Orinoco.

The interior of this government is covered with mountains, some of which have a great elevation. The highest of these, called Tumeriquiri, is more than 5600 feet above the level of the sea. The immense cavern of Guacharo, so famous among the Indians, forms a part of this mountain. It has a majestic situation, and is remarkable for the richness and luxuriance of its vegetation. A considerable river flows from the cavern; and there also issue from it the cries of millions of night birds, to whom it serves as a habitation. These sounds are ascribed by the Indians to the spirits of the dead, who can find a passage to the other world only by sojourning for a time in this gloomy abode. This privilege, however, is granted only to the virtuous, and the period of their detention is proportioned to the extent of their offences. Hence it is the practice of the Indians to repair to the cavern, to ascertain whether their deceased friends have been ranked among the blessed, and if they distinguish their voice, they conclude that some impediment has been thrown in the way of their final liberation. In the mountains of Cumana, but particularly those of Tumeriquiri, there is a stratum about 18 feet thick of limestone and argillaceous earth, mixed with a very considerable quantity of coal. Above this stratum is frequently found another, apparently modern, of sandy earth, which is a mass of shells, quartz, and secondary limestone. At the depth of about 30 fathoms, these strata appear to be of pure limestone. A careful examination, however, will soon detect the quartz, and the limestone now disappears by degrees, till scarcely any thing else but quartz can be perceived. Mines are said to have been successfully wrought in the valley of Neyva; and it has been supposed, that there is a great quantity of gold in the country from Torayena to La Plata. Mines of coal also occur in this province.

Numerous rivers, streams, and brooks, intersect Cumana in every direction. The rivers Neveri and Mansanares, which are small, and have a gentle current, discharge themselves into the sea on the north. Those which flow into the Gulf of Paria, and into the sea on the east, have much longer courses. The Colorado, the Guatator, the Caripa, the Punceres, the Tiger, the Guayuata, discharge themselves into the Guarapicha, which runs into the Gulf of Paria, and is navigable about 80 miles from its mouth. The remaining rivers flow to the south, and join the Orinoco.

But though these natural canals afford the most admirable means for irrigating the land, and transporting its produce, yet the natural fertility of the soil has received almost no aid from the hand of cultivation. From the river Unara to the city of Cumana, the land has considerable fertility; but it is poor and sandy, from the point of Araya for about 25 leagues to the east. It is, however, an inexhaustible mine both of marine and mineral salt. The principal saline grounds are at Araya, and those of the Gulf of Paria or Triste, between the settlements of Iraca and Soro. The lands on the banks of the Orinoco are fit only for pasturing cattle; but all the rest of the government possesses the most surprising fertility. The principal productions are maize, which supplies the want of wheat; yuca root, which affords another kind of bread; cazabe, cacao, sugar canes. The quantity of sugar produced is sufficient only for the consumption of the province; but on an average of four years, from 1799 to 1803, the quantity of cacao exported from the province amounted to 18,000 fanegas, of the weight of 50 kilogrammes each, or 110 pounds avoirdupois.* The most precious trees, the guiacum, the anacardium, Brazil and Campeachy wood, are found even on the coast of Paria. Abundance of shell fish, of various kinds, and the finest flavour, is obtained in every part of the coast. A great quantity is salted, and carried into the interior; and the province of Venezuela alone, is supplied with above 3000 quintals annually.

The principal colonies dependent on Cumana lie on the western coast, as Barcelona, Piritu, Clarinas, &c. In the valley of Cumanacoa, about 12 leagues to the south-west of Cumana, are the tobacco plantations belonging to the king. The tobacco, which is here produced, is so decidedly superior to that which is raised in every other part of Terra Firma, that the cigars made of it bring double the price of any other. The Indian villages of San Fernando, Arenas, and Aricagua, are situated on the most fertile territory in the environs of Cumanacoa. The fertile but uncultivated valleys of Carepa, Guanaguana, Cocoyar, &c. are situated still farther in the interior.

The refugees from Trinidad, who inhabit the coast of the Parian Gulf from the mouth of the Guarapicha to the most northern mouth of the Orinoco, frequently make great progress in cultivation, owing principally to the proximity of the British settlement, from whom they receive at a cheap rate, and even upon credit, all the iron work necessary for their establishments, and to whom they dispose of their commodities at prices far superior to those which prevail in the Spanish ports.

The climate of Cumana is healthy, though it is scarcely ever cool. In the town of Cumana, Reaumur's thermometer stands in July at 23° in the day-time, and 19° during the night, the maximum being 27°, and the minimum 17°. The hygrometer of Deluc indicates from 50 to 53 degrees in the same month, the maximum being 66°, and the minimum 46°.

The governor, who has his residence at Cumana, is appointed for 5 years. He nominates to all the vacant benefices in the administration of the finances; in all commercial regulations, he acts under the orders of the intendant; and in all military concerns, and foreign political relations, he is subordinate to the captain-general of the Caraccas. The principal cities and towns of this province, are the capital Cumana, (see the next article,) Cumanacoa, Coriaco, New Barcelona, and Conception del Pao. *Cumanacoa*, called *San Baltasar de los Arias* by the government, is situated in a valley of the same name, about 14 leagues south-east of Cumana, in west longitude 63° 58′ 35″, and north latitude 10° 16′ 11″. Its climate is good, and its waters have a diuretic quality. It has a population of 4200. *Coriaco*, otherwise called *San Philippo de Austria* in some official papers, is situated on a river of the same name. Its principal production is cotton, which is the best in Terra Firma, and of which it furnishes 3000 quintals annually. A little cacao and some sugar are also raised. The population is 6500. *New Barcelona*, founded in 1634, is situated in west longitude 64° 44′ 30″, and north latitude 10° 6′ 52″, in a plain about a league from the mouth of the Neveri, and on its left bank. It is neither a handsome nor a pleasant town. Its unpaved streets are loaded with mud in rainy weather, and covered with dust in the dry season, and every part of the town is annoyed with the stench of its numerous hog sties. Great quantities of meat were salted here, and exported to the neighbouring islands, particularly to the Havannah and Cuba, at a profit of a hundred per cent. The hides and tallow formed also another article of trade, but it is now much diminished. The Catalonians who reside here, carry on both a legal and an illicit traffic to a great extent. They bring from Trinidad contraband goods, of which Barcelona is the entrepot,

* See Humboldt's *Political Essay on the Kingdom of New Spain*, vol. iii. p. 24.

Cumana.

and from which they are distributed both by sea and land. About four hundred thousand hard dollars are annually exported for this clandestine traffic. The population, which consists of one half whites and the other half people of colour, amounts to 14,000. *Conception del Pao* is 55 miles from Cumana, and contains a population of 2300 souls, who live comfortably on the productions of the soil. The air and water are good, but the heat is excessive, and the inundations frequent. The population of the government of Cumana is estimated at 80,000 souls. (*w*)

CUMANA, the capital of the government of the same name, is situated on a dry and barren soil, about a quarter of a league from the sea, and about 53 feet above its level. It was built by Gonzalo Ocampo in 1520, and is the oldest city in Terra Firma. The river Mansanares surrounds the city on the south and west, and separates the town from the suburbs, which are inhabited by the Guayqueris Indians. The city is much more than four times as large as it was fifty years ago, and the ancient scite of the town has been so crowded with buildings, that the inhabitants have been under the necessity of building on the left bank of the Mansanares, to the west of the Indian suburbs. This new town communicates with the city by a bridge; and in 1803, a church was erected for its particular accommodation. The first street that was laid out was called Emparan, after the governor of that name, who, in the war between 1793—1801, admitted neutral vessels into the harbours in opposition to the order of his superiors,—a resistance which gave prosperity to the province, and was amply rewarded by his Catholic Majesty. The houses are low and slightly built, owing to the sufferings which have been experienced from frequent earthquakes. The earthquake of December 1797, threw down almost all the stone edifices, and rendered the rest uninhabitable. The earthquake of November 1799, produced a variation in the needle of 45°. Humboldt imagines, that these earthquakes are owing to the proximity of Cumana to the Gulf of Coriaco, which appears to have a communication with the volcanoes of Cummucuta, which emit hydrogen gas, sulphur, and hot sulphureous water. The town is defended by a fort situated on a hill, which extends along the eastern side of the city. It is garrisoned by 231 regulars, and a company of artillery. There is only one parish church in Cumana, (excepting the one already mentioned,) which is situated to the south-east of the city, near a demolished fort. There are two monasteries, one belonging to the order of St Dominic, and the other to that of St Francis.

The river Mansanares is so shallow, that it is navigable only for small craft. Merchant vessels anchor upon what is called the Placer, a sand bank, which lies west from the river about a league from its mouth, and opposite to a stream called Bardones. It is, therefore, necessary to load and unload the vessels with the assistance of lighters. The port, however, has the advantage of being well sheltered from inclement weather.

The population of this town consists principally of White Creoles, who are remarkable for their natural abilities, and their attachment to their native soil. Commerce, navigation, the fisheries, and agriculture, are the general sources of their subsistence. An immense quantity of salted fish is shipped to the Caraccas and other neighbouring cities, and also to the Windward Islands, from which they bring back iron implements of agriculture, provisions, and contraband goods. The Catalonians, and some of the Canary Islanders, carry on the chandlery and retail trade. The principal articles of commerce, besides those already noticed, are cacao nuts and the oil which they afford. Medicinal plants, and a variety of aromatic herbs, might form an important article of commerce, if the inhabitants were able to prepare them. Population 24,000. West Longitude 64° 9′ 45″, and North Lat. 10° 27′ 37″. See Depon's *Travels in the Caraccas*, passim; Humboldt's *Political Essay on the Kingdom of New Spain*; Thomson's *Alcedo;* and Peuchet's *Dictionnaire Commerçante de la Geographie*, &c. (*w*)

Cumberland.

CUMBERLAND is the county which forms the north western extremity of England: it is situated between the latitudes of 54° 6′ and 55° 7½′ north, and between the longitudes 2° 13′ and 3° 30′ west from London. Measured in a north-easterly direction, from St Bees-head to Buttern Burn, its length is 58 miles; but if a line be drawn from its north-eastern to its southern point, its length is nearly 80 miles. Its greatest breadth is 40 miles; but this is only in a small part. Its mean breadth in a north-west direction is 30 miles. It is bounded on the east by Northumberland for 51 miles, from which county its dividing limits, with the exception of the river Irthing, for a very few miles, are artificial; and on the same quarter by Durham, from which its dividing limits are entirely artificial. On the west it is bounded by the Irish sea, for the space of 67 miles: on the north by Scotland and the Solway Frith for 30 miles: the Scotch dyke and the river Liddel form the limits between it and Scotland on the land-side: on the south it is bounded by Westmoreland for the space of 48 miles, from which it is partly separated by Ullswater and the river Eamont; and on the same direction it is bounded by Lancashire for 21 miles, from which it is separated by the river Duddon. The whole circumference of Cumberland is 224 miles; and it contains 1516 square miles, or 970,240 acres; of these, it is computed, that the mountainous districts occupy 342,000; that 470,000 are enclosed and under cultivation; but the number of enclosed and cultivated acres is fast increasing; that about 150,000 acres are in low commons, great part of which are capable of improvement; and that the lakes and waters occupy 8000 acres. The form of the county is very irregular; on the west it projects into the Irish sea, with a convexity like a long-hooked beak, the point of which descends to the detached part of Lancashire. It is divided into five wards: Cumberland-ward, Eskdale-ward, Leath-ward, Allerdale-ward above Derwent, and Allerdale-ward below Derwent. The natural divisions are into the low or arable, and the mountainous: Of the mountainous districts, there are two divisions, one of which bounds the east side of the county, and is the highest part of the English *Apennines*: the other division of mountainous district occupies the south-western part of the county, forming high, steep, and craggy hills, of romantic shapes. The first mountainous district is composed of strata of different kinds of stone, and is rich in coal, lead, and lime: the second mountainous district is destitute of these, but affords, in great abundance, the beautiful blue slate which is used for covering houses: black lead is also found in this district. In front of the first mountainous division, a tract of low ground, of considerable breadth, is stretched, partly cultivated, and partly heathy common, which is watered by the Eden, and a great number of small brooks: as this tract approaches

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Carlisle, its extent enlarges, stretching across the county to Wigton, and thence towards Workington, so that it includes nearly the whole northern portion of Cumberland. A strip of cultivated land stretches along the western shore, from two to five miles in width. The general character of this county is that of bleak mountains, naked moors, and wild wastes: there are very few woodlands: the Irthing, Eden, and Caldew, are the only rivers whose banks produce any quantity of natural wood. The climate of Cumberland is very variable, from the circumstances of its having such an extent of sea-coast, and so large a portion of it being occupied by mountains. The lower parts of the county are mild and temperate, the snow seldom lying near the coast for twenty-four hours; while, on the mountains, it may be seen for six or eight months. A very considerable quantity of rain falls all over the county, but especially near the mountains: the season of the year most liable to heavy rain is the autumn. The neighbourhood of Keswick is supposed to be as rainy as any part of the kingdom: the quantity of rain varying, from the observations of seven years, from 64 to 84 inches. The rivers and rivulets of Cumberland are very numerous: the principal are the Eden, the Eamont, the Duddon, the Derwent, the Greata, the Cocker, the Caldew, the Esk, the Liddel, and the Irthing. The Eden rises in Westmoreland, and enters Cumberland at its confluence with the Eamont; it flows into the Solway Frith near Rock-cliffe Marsh, where it forms a very fine estuary: the vales between its banks and the hills vary in breadth from 20 yards to half a mile: they are provincially called *Holm* lands, and are very fertile. The Eamont rises in Kirkstone in Westmoreland, one of the most romantic mountains in England; and passing through the vale of Patterdale to Ullswater, soon afterwards unites with the Eden. The Duddon rises near the shire-stones, which mark the union of Cumberland, Westmoreland, and Lancashire: it runs, during its whole course, through a narrow dell, skirted by mountains and high lands. The Derwent rises among the crags at the head of Borrowdale: its stream is very precipitous, being dashed from rock to rock till it flows into Derwent lake, at the foot of which it unites with the Greata; and after passing through Bassenthwaite water, and flowing through a narrow vale, it is joined by the Cocker at Cockermouth, and falls into the sea at Workington. The course of the Cocker, which springs from a mountain near the black lead mines, is peculiarly beautiful, from the variety and romantic character of the country through which it flows. The Caldew rises on the south side of Skiddaw: its banks are very woody; its vales rich and beautiful, and the quality of its water is thought peculiarly excellent for bleaching: it turns a number of corn and cotton mills. The Esk rises in Scotland, and enters Cumberland at a place called the *Moat*; after which, flowing through a beautiful vale, and passing Longtown in a westerly direction, it falls into the Solway Frith. The Liddel also rises in Scotland, and enters this county at Kirshope-foot; it passes through a wild and romantic country, in a deep and narrow valley, in one part of which the rocks rise to a great perpendicular height, covered with trees and bushes; it afterwards joins the Esk. The Irthing rises on the hills which lie on the borders of Northumberland, and falls into the Eden, near Newby: in some part of its course, the scenery on its banks is very rich and beautiful.

Climate.

Rivers.

The soils of Cumberland are rich, strong loams: these, however, occupy a small part of the county. Dry loams, which occupy a greater portion than any other, nearly one half of the lower districts, or those capable of cultivation, being of this soil: wet loam, and black peat earth, which is in greatest abundance on the mountainous districts, particularly those adjoining Northumberland and Durham: it is also found on moors and commons in the lower parts of the county, lying on a white sand: with this subsoil, it is most particularly ungrateful and unprofitable. In Cumberland, there are a greater number of very small estates than perhaps in any other county in the kingdom: many of them as low as L. 5 a year; and this kind of property does not often exceed L. 50, and seldom reaches L. 100: the generality of these tenements are from L. 15 to L. 30 a year: they are almost universally occupied by the owners. The rental of the largest estate is said to be about L.15,000 per annum. The greatest part of the land is held by customary tenure; which, besides being subject to the payment of the usual fines on alienation, death, &c. are held under the condition of various services, called *boon days*; such as getting and leading the peats of the lord of the manor, ploughing and harrowing his land, reaping his corn, carrying letters, &c. It is supposed that two-thirds of the county are held by this kind of tenure: the remaining part is generally freehold: copyhold and leasehold are rarely met with. The general size of farms is very small; but these small farms are gradually uniting into larger. Farms below L. 100 a year are the most common: scarcely any reach L. 500 a year. The most singular class among the Cumberland farmers, are the "lairds," or "statesmen," as they are provincially termed: they are the proprietors and farmers of the small tenements already noticed: they retain all the honesty, simplicity, and prejudices of ancient times: they cultivate their estates with their own hands, grow or manufacture every thing they need, and keep aloof alike from the increasing knowledge and vices of the age. Leases are very unusual in Cumberland, and never extend beyond seven or nine years. Much land is held on verbal contracts: besides the rent, many services are required of the tenant, such as grinding corn at a particular mill, supplying the landlord's table with a certain number of chickens, &c. Although this county is so very hilly, the roads are excellent: this may partly be ascribed to the easy and full supply of good materials, and to the universal use of single horse carts, which not only save the roads, but enable the farmer to lay a greater weight on the same number of horses: three of these carts are driven by a man, or a boy, or even women and girls: along the coast, more than half the carts are driven by females, generally under 20 years of age. Formerly grazing was more attended to than the raising of corn; but latterly, especially on the rich strong loams, tillage has greatly increased. There is nothing particularly worthy of notice in the agriculture of Cumberland: the native cattle are a small breed with long horns: great numbers of these are reared and sold to drovers, who bring them into the southern counties to fatten, under the name of Cumberland *steers*. The dairies are small, but the butter is of an excellent quality; a good deal is exported. There are two kinds of sheep, one peculiar to the exposed and rocky districts, called the *Hardwicke* breed: they are polled; mostly white, with a few black spots, with fine small clean legs; they are well adapted to their situation: they are rarely covered or overwhelmed in storms of snow, as they not only gather together in such circumstances, but keep stirring

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about, by which means they tread down the snow and keep above it. The other kind of sheep are the black-faced, coarse woolled, heath sheep, the flesh of which is of a most delicate flavour. Of the manures used in Cumberland, the only one requiring notice as peculiar to this county, is mussels: these are laid on the land in the neighbourhood of Ravenglass, at the rate of five or six cart loads per acre: they are found in great abundance on the lands adjoining the coast. It has been accidentally discovered on the estate of Lord Muncaster in this county, that sea-sand will destroy moss, but it is not used as a manure.

Manufactures.

Manufactures are not extensive or numerous in Cumberland: the principal are the spinning and weaving of cotton into calicoes, corduroys, and other articles. Cotton spinning was first introduced at Dalston, from which place it has extended to Carlisle, Warwick-bridge, Corby, Comersdale, and a few other places. There are small manufactories of checks and coarse linens in some of the market towns. Cotton printing is carried on at Carlisle on a pretty large scale. At Whitehaven and Egremont, there is a manufacture of sail cloth. There are also a few paper-mills, and a manufactory of coarse earthen ware near Dearham. On the borders of the Derwent, above Workington, are the Seaton iron works, which employ several hundred men. They were erected in 1763. They consist of two blast furnaces for melting iron ore; a mill for the rolling and slitting of bar iron, and a double forge for refining and drawing it; a foundery with various small furnaces, for casting cannon and iron work of all kinds; a mill for boring cannon, cylinders, and many other contrivances suitable to the nature of the manufacture. The exports of this county consist principally of coals from Whitehaven, Workington, and Maryport, to Ireland. In 1566, there was but one vessel belonging to Cumberland that was of 10 tons burden; now there are upwards of 300 from 60 to 120 tons employed in the coast trade alone. In 1566, the whole exports consisted of a small quantity of herrings and cod fish, and the only thing imported a little salt. In 1582, on a survey being taken of the ships and mariners within this county by the Earl of Lincoln, who was at that time Lord High Admiral, the vessels amounted only to twelve, and one of which was of 80 tons burden; the mariners and fishermen were 198. In 1607, Workington was the principal seaport. Criminals sentenced to banishment in Ireland, were shipped from hence. Besides coals, butter, bacon, and hams are also exported, most of which, and likewise some salmon, go to the London market.

Commerce.

Mountainous scenery.

To the admirer of the grandeur and beauties of nature, the mineralogist, and the antiquarian, Cumberland is a very interesting county. The mountains of Cumberland not only afford very extensive and grand views, but many of them are of singular structure, and immense elevation. As we enter the county at the south-west corner, a high conical-topped hill, with smooth and cultivated sides, affording an extensive view from its summit, presents itself. It is called Blackcomb. On the southern borders of the county are Hardknot and Wrynose; and on the margin of Bassenthwaite lake the roots of Skiddaw lie. This majestic mountain is nearly 3500 feet in perpendicular height above the level of the lake. The prospect from its summit is uncommonly varied and extensive. On one side the Irish Channel, on the other side the German Ocean, may be seen. On a clear day, the shipping in the Solway Frith, though at the distance of upwards of fifty miles, may be distinguished. On Bouscale Fell, to the north-east of Skiddaw, is a spacious lake of water so completely enclosed by a ridge of rocks, that, during months in winter, the rays of the sun never reach its surface. On Souter fell, which is nearly 900 yards high, extraordinary phenomena appeared towards the middle of the last century, which gave rise to much speculation, and created no small degree of alarm and apprehension. Appearances of armed men, on foot and horseback, were seen. They moved in regular troops along the side of the fell, describing a kind of curvilinear path, their first and last appearance being bounded by the top of the mountain. From the description given of these phenomena, they seem to have been similar to the spectre of the Brocken, an aërial figure that appears among the Hartz mountains in Hanover, and were probably produced by the same cause. Saddleback, on the western side of Souter fell, seems to have been in a volcanic state; and a lake on the upper part of it, from the lava and burnt stones found in its neighbourhood, is conjectured to have been the crater. The views from the summit of Saddleback are very extensive; but it is scarcely possible to look down its sides without experiencing the most awful and shuddering sensations. The height of this mountain is 3324 feet. In the vale of Wanthwaite, which stretches at the bottom of the southern declivity of this mountain, is a singular piece of scenery. A castle of great antiquity, and in ruins, seems to stand on the summit of a little mount. It shews a front of various towers, with lofty turrets and ragged battlements. Even the galleries, the bending arches, and the buttresses, may be traced. Such it appears when viewed from the widest part of the dale; but as it is approached its figure changes, and it is discovered to be a massive pile of rocks, disunited from the adjoining mountains. The inhabitants called them the castle rocks of St John, and believe them to be an artificial but antediluvian structure. The rocky chasm of Borrowdale opens from the centre of the amphitheatre, that binds the head of Derwent-water. "Dark caverns yawn at its entrance, terrific as the wildness of a maniac, and disclose a narrow strait running up between mountains of granite, that are shook into almost every possible form of horror, and resemble the accumulations of an earthquake, splintered, shivered, piled, amassed." "This region of desolation furnishes a succession of such romantic and picturesque scenes, as can hardly be equalled in the island. Near the entrance of the pass into Borrowdale, is a detached mountain called Castlecrag, the views from which are very peculiar. On one side, every thing indicates civilization and repose, and fills the mind with soft and mild emotions; the vale and lake of Keswick, with villages, seats, and farm-houses. On the other side every thing is terrific, and bespeaks the convulsions of nature; immense rocky mountains huddled together in the most singular arrangement, as if emerging from, or returning to, the wildest chaos; rock rests over rock, and mountain triumphs over mountain." In one of the recesses of Borrowdale, and nearly opposite Castlecrag, is a gigantic rock called the Bowder Stone. It lies almost hollow, resting on some fragments of rock. Its veins are exactly similar to those of the adjoining precipice, though it is not easy to conceive how, if it ever formed part of it, it could have reached its present position. Its length is about 31 yards, and it is computed to weigh nearly 1800 tons. Helvellyn, which lies to the south-east of Borrowdale, is partly in Westmoreland. Its height is 3324 feet. On account of its being at a greater distance from the sea, the snow lies longer on it than on Skiddaw. The pros-

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pect from its summit is very extensive. Crossfell is the highest part of the mountains on the east side of Cumberland. Its height is 3390 feet. The prospect from it is calculated to include a diameter of more than 100 miles, and to comprehend great part of six counties. On it occurs the singular phenomenon called a *helm-wind*. Its appearance is that of an enormous white cloud resting on the summit of Crossfell, which it covers like a *helmet*, whence it takes its name. When it first begins to gather, a black stripe of cloud is seen continually flying off, which is called the *Helm-bar*, because, while it continues, the wind is thought to be confined, for as soon as the black cloud is dispersed, it rages with great violence. While the helm is perfectly motionless, the bar is in continual agitation. It is observed, that the storms of wind, which rise on one side of the mountain, seldom affect the other; and what are called in this county *shedding winds*, generally blow on the contrary side of Crossfell from opposite quarters to the *helm-winds*. While the latter blow, the atmosphere is extremely chilly, but its warmth is restored by the rain, which generally terminates this phenomenon.

Lakes

Of the lakes in Cumberland, which are very numerous, the most celebrated for their scenery are Derwent-water, or Keswick lake, and Ullswater. The form of Derwent-water is very irregular, somewhat approaching to the oval. It extends from north to south about three miles and a half; its breadth is about one and a half; its greatest depth is 20 feet, in a channel running from end to end, probably formed by the river Derwent. The two extremities of this lake afford prospects of a very opposite character. From the southern extremity, an immense chasm opens in the midst, the entrance of which is divided by a rude conic hill; beyond, broken mountainous cliffs soar one above another, overshadowing the dark and winding deeps of Borrowdale. From the northern extremity, Skiddaw shows its vast base, and, "bounding all that part of the vale, rises gently to a height that sinks the neighbouring hills, and opens a pleasing front, smooth, verdant, and smiling." On the southern side of the lake is the cataract of Lowdore, which consists of a series of cascades, tumbling over an extent of precipitous rocks, which are partly concealed by the trees that grow on the numerous fissures. The height of the fall is nearly 200 feet. Nearly opposite to this fall, small islands are said to have been occasionally seen floating about, appearing for a few days, and then becoming invisible for weeks or months, and sometimes for years. The waters of this lake are frequently agitated with what is called a *bottom wind*; they swell in high waves even when there is a perfect calm; the motion is from west to east, and continues sometimes only for an hour, sometimes for a whole day. Ullswater, which is partly situated in this county and partly in Westmoreland, is not nearly so beautiful as Derwent-water, but it possesses a much larger proportion of dignity and grandeur. Its shape is somewhat like the letter Z, only the angles are less acute. Its length is 9 miles; its breadth little more than one. A vast rock projects in its second reach, which reduces its breadth to less than a quarter of a mile. The character of the first reach, as viewed from the foot of Dunmallet, is nearly that of simple grandeur. The characteristics of the left shore of the second reach, are grandeur and immensity. The finest perspective in the lake, is that which is seen as the road descends into Gowbarrow Park, which can scarcely be equalled for alpine sublimity. But the most various and extensive view that the shores of Ullswater exhibit, is gained from an eminence near Glencoyn woods. This view comprehends both the reaches, and though not the most picturesque, is certainly the most grand. The sublimity of the view of the last reach, is much lessened by the rocky islets with which it is spotted, which do not accord with the tremendous mountains which hang over the entrance of Patterdale, nor with the massy and broken cliffs on the eastern shore. The rocks of this lake are celebrated for echoes exceedingly grand and impressive. Char, gwinniard, and trout of a peculiar species, of the weight of 30 pounds and upwards, are caught in Ullswater.

Mineralogical productions.

Cumberland is very rich in mineralogical substances, which are, however, so numerous, that they can be only briefly mentioned in this article. Limestone is found at Overend, with ammonitæ, entrochi, and asteriæ in it; and at Gilsland with a great variety of marine exuviæ. Marble of different colours, and finely veined, free from cracks, and admitting of a high polish, is met with at Kirkoswald and other places. The lead mines of Aldston Moor are rich in a great variety of substances of the calcareous genus. In the mines situated between this place and Keswick, spar, crystallized in hexagonal prisms, terminated at one end by a pyramid, is not uncommon. Sulphate of lime, compact, foliated, and crystallized in the latter state with the crystals disposed like a cock's-comb, is met with at Newbiggen. In this place it is imbedded in red argillaceous marl, between strata of sandstone, the upper solid and fine grained, the under loose and coarse. In some places, below the strata of gypsum, there is a thin bed of decayed wood. Most of the sand-stones contain mica, and silvery mica is met with in the quarries on the Peterel. Soap rock has been found semi-indurated, at Hill-top and St John's, and solid at Borrowdale and other places. The lead mine at Northend, and some of the mountains, afford asbestos. Quartz crystals of the yellow kind, little inferior to the Brazilian topaz, occur in Aldston Moor; and small garnets have been met with in the neighbourhood of Keswick. Trap, whinstone, loadstone, and argillaceous schistus, are very common. The last forms the summit of Skiddaw. Kaolin is found at Barrock, near Nebsteps; and tripoli has been discovered on the banks of Ullswater in gravel beds; and in coarse clays, jet, bearing a fine polish, is sometimes met with in the rocks on the Irthing. It is wrought into toys, bracelets &c.

Coal mines.

Coal is very abundant near Whitehaven and Workington. Near the former place, the beds of coal are 9 or 10 feet thick, and dip to the west 1 yard in 8. In various parts, are great bars of stone which cut off the coal. If they bend one way, the coal rises up; if another, it sinks down. The mines are sunk to the depth of 130 fathoms, and are supposed to be the deepest that have been hitherto wrought; the extremity of the principal mine extends two miles from its entrance, and is beneath the sea a considerable way. The coal mines near Workington are not near so deep as those near Whitehaven, generally from 40 to 90 fathoms. The coal lies in seams, divided from each other by intermediate strata; the upper seam is generally 3 feet thick; the second 4 feet; and the third from 10 to 12 feet: they do not work below this seam.

Lead mines.

The principal lead mines in Cumberland are at Aldston Moor, on the borders of Northumberland. The lead ores lie in cracks or fissures, that are never wholly perpendicular, and they always incline downwards from that side where the strata are highest. A considerable proportion of silver is not unfrequently found in the

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ores of lead. The *breaks* that are met with, are generally incrusted with beautiful spar. About 11,000 men are usually employed in the Aldston Moor lead works, and the owners are said to clear upwards of £16,000 per annum.

Copper mines.

Copper ores combined with sulphur, and containing iron and arsenic, are not uncommon; The principal copper mines are near Caldeck, in Borrowdale, and at Newlands. At the last place, the celebrated mine of Goldscarp is situated, from which, in former times, immense quantities of copper were procured. In the parish of Egremont, is one of the most singular mines of iron ore in the kingdom. It lies at the depth of 12 fathoms. The thickness of the seam, which is hard solid metal, is between 24 and 25 feet. It was not much wrought till 1784. Great part of the ore is sent to the Carron foundery. Native Prussian blue is sometimes found in the peat mosses of Cumberland. Oxide of lime, cobalt, antimony, oxide of manganese, and wolfram, likewise occur in different parts of the county.

Black lead mines.

But the most singular mineral production of Cumberland is black lead. The mines are situated at the head of Borrowdale. The black lead lies in the mine in form resembling a tree: the root contains the finest, the branches the worst, and the quality declines as their distance from the stem increases. Sometimes the extremity of the branches appears on the surface of the ground. There are two workings; the lower 340 yards above the level of the sea; the upper nearly 390: the perpendicular height of the former is about 105 yards, of the latter about 30. The black lead is generally embedded in the fissures of a blue rock, and is found in irregular masses. Between the rock and the black lead, there is sometimes a wet *sludge*. In some places in the mines, *sops* or lumps of the mineral are found without branches. In the deepest mine, two veins cross each other; and the lead is richest, and in greatest abundance, at the point of intersection. It is not known when this mineral was first discovered. An act of parliament was made in the reign of George II. to prevent its being stolen, in consequence of the owner of a contiguous part of the mountain having secretly sunk a shaft, and opened a passage diagonally to the mine. At that time, from the words of the act, it seems to have been principally used in the casting of bomb shells, round shot, and cannon balls. In order not to overstock the market, the mines are only opened at intervals for a short period, and while they are wrought, the labourers are watched and examined very narrowly. Over each entrance a house is built, which is occupied by the stewards and workmen.

Mineral waters.

Gilsland Spa, in the vale of Irthing, about eight miles south-east of Bewcastle, is much frequented. The principal spring is strongly impregnated with sulphur, but not so disagreeable to the palate as springs of this kind usually are. At a small distance is a chalybeate spring, and four miles off another impregnated with alum and vitriol. The banks of the river near the Spa are very interesting to the geologist, as the stratification is completely exposed to view. The height is forty yards: The mould occupies six inches; coarse clay tinged with oxide of iron, five yards; argillaceous shiver, two yards; coarse freestone, eight yards; limestone, one yard; black shiver strongly impregnated with alum, one yard; schistus, sandstone, ironstone, and limestone, curiously intermixed, six yards; another stratum of black shiver, from which the sulphureted water issues; and below this indurated argil, called *clunch*. About the year 1695, a patent was granted to some gentlemen for pearl-fishing in the river Irt, near Ravenglass; and one person is said to have obtained as many as he sold in London for L. 800. None are met with now. On the Derwent, a singular mode of catching salmon is practised by persons on horseback, termed *Salmon-hunters;* they carry a spear with three points, with a shaft fifteen feet long. The huntsman plunges into the water, and while at a swift trot strikes the salmon, which, by a sudden turn of his hand, he raises to the surface, and, without dismounting, runs it the readiest way to dryland.

Antiquities.

There are several Druidical and Roman antiquities in Cumberland; of the former, the most remarkable and celebrated is an extensive circular arrangement of rude and unhewn stones in the parish of Aldingham, about three miles from Kirk-Oswald, called *Long Meg and her Daughters*. This monument is nearly 350 yards in circumference: it consists of sixty-seven stones, some nearly ten feet high, and from twelve to fifteen feet in girth. The smallest are only about two or three feet high, and of proportional diameter. They are placed at regular distances on the south side; but on the north, east, and west, between two stones rather larger than the rest, the distances are greater. Without the circle, opposite the south-west, two stones are placed; and about seventeen yards farther off is the stone called Long Meg, which is eighteen feet high, and at its greatest diameter nearly fourteen in girth. It is a freestone, similar to what is found in a quarry a few miles distant. Of the rest, some are flint, and many granite, which must have been brought from a considerable distance. There is no mark of a tool on any of them. What is commonly called the Picts Wall, is the principal antiquity of Roman origin. It runs from the river Tyne on the east, to the Solway Frith on the west. It was begun by the Emperor Adrian, against the incursions of the Brigantes and the Caledonians. At first it was built in the manner of a mural hedge, with large stakes wreathed with wattles. It was repaired by the Emperor Severus, or rather rebuilt with stone, and strengthened by a ditch and a chain of forts. About the year 430, just before the Romans left Britain, this wall was repaired, and rendered still stronger. From Staniwix, a little village north-west of Carlisle, where the Picts' wall crosses the Eden, its remains may easily be traced westward to its extremity at Bulress, a small town on the Solway Frith. From Staniwix it may also be traced eastward for nearly eight miles; but in this space only the foundation of Severus' rampart, and the trench of Adrian, can be discerned. Farther to the east it runs up a high hill; from whence, till it crosses the Irthing and enters Northumberland, it is entire, in some places to the height of five feet, and in others to the height of eight feet.

Cumberland contains one city, 17 market towns, and 112 parishes. The ward of Allerdale is in the diocese of Chester, the rest of the county in that of Carlisle. It sends six representatives to parliament, pays one part of the land-tax, and raises 200 men for the militia.

History.

Most antiquarians are of opinion, that Cumberland, at the time of the Roman invasion, was inhabited by the *Brigantes*. Mr Whitaker, however, maintains, that the *Voluntii* inhabited it as far as Adrian's wall on the north. Its inhabitants were very warlike, and were never completely, and for any length of time, subdued by the Romans. It seems to have been governed by its own princes, after the Romans left Britain, till the 10th century, when, according to some writers, it was

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conquered by King Edmund, who granted it to Malcolm, king of Scots. This opinion, however, is controverted by other writers. Mr Pinkerton thinks that Cumberland was conquered by the Scots, and that they possessed it by right of conquest, and not by any grant from the English; and this opinion seems to be confirmed by the circumstance, that it is omitted in Doomsday-book, which it could not have been had it been a grant from England. In 1072, William the Conqueror conquered, or re-assumed the grant of Cumberland, and bestowed it on Ranulph de Moschines. When Stephen set up his claim to the crown, in order to prevent the interposition of the Scots, he consigned to them Cumberland, as well as Northumberland and Durham. In 1154, Malcolm IV. gave up his claim to this county, in return for a confirmation of his claim to Huntingdonshire. From this period till the middle of the 13th century, there were frequent disputes between the Scots and English monarchs respecting their right to it, till, at a conference held at York, Henry III. in full satisfaction of all the claims of the king of Scots, agreed to assign lands of the yearly value of L. 200 within the counties of Northumberland and Cumberland. Notwithstanding this adjustment, there was still a tract between the two kingdoms not immediately subject to either, called *Debatcable Ground.* This was inhabited by a lawless banditti, who invaded and plundered both countries, and, quarrelling among themselves, frequently gave rise to wars between the Scotch and English nations. For the regulation of the Borders, Edward I. appointed a lord warden of the marches; but the banditti still continued numerous, powerful, and beyond the reach or controul of the law: And border depredations were very frequent even in the reign of Elizabeth. James I. in order to extinguish all memory of hostilities between the two kingdoms, prohibited the use of the term *Borders,* substituting in its stead that of *Middle Marches;* but it required almost 100 years after this period to wear off the jealousies and antipathies of the English and Scotch *Borderers* to each other. After Henry II. resumed the grant, the honour remained with the crown till the time of Henry VIII. who created Henry Clifford earl of Cumberland. The title continued in the family of the Cliffords till 1643, when male issue failing, the honour ceased for a time. In 1644, Charles I. created his nephew Prince Rupert Duke of Cumberland; and the title henceforth has been appropriated to one of the royal family.

Population.

The following statistical abstract for this county, is taken from the population-return for 1811:

Number of inhabited houses	24,002
Families that occupy them	28,390
Houses building	130
Uninhabited houses	550
Families employed in agriculture	10,868
——— trade, manufactures, &c.	11,448
——— not included in these classes	6,074
Number of males	63,433
——— females	70,311
Total population	133,744
Population in 1801	117,064
Increase	16,680

See Bailey and Culley's *Agricultural Survey of Cumberland.* Pennant's *Tour in Scotland,* vol. i. *Magna Britannia,* vol. i. *England Illustrated,* vol. i. *Beauties of England and Wales,* vol. iii. Hutchinson's *History of Cumberland.* Gilpin's *Observations relative chiefly to Picturesque Beauty on the Mountains and Lakes of Cumberland and Westmoreland.* Mrs Radcliffe's *Journey to Holland; to which are added, Observations during a Tour to the Lakes.* Warner's *Tour through the Northern Counties of England.* (w. s.)

Cumberland, Richard.

CUMBERLAND, Richard, was born February 19, 1732, in the master's lodge of Trinity College, Cambridge. His father was a clergyman in Northamptonshire, and grandson of the learned bishop of Peterborough; his mother was the younger daughter of the celebrated Doctor Bentley, and the Phœbe of Byron's Pastoral. At the age of six he was sent to the school of Bury St Edmund's, then under the mastership of the Rev. Arthur Kinsman. There he manifested a great inaptitude to learn. His mind seemed to have no cleverness nor vigour. What was perhaps worse, he was supremely idle; and accordingly he gradually took, and for some time resolutely kept, his station at the bottom of the class. His worthy teacher, however, remonstrating with him on his indolence and want of spirit, and reminding him of what was expected by his maternal grandfather, succeeded in rousing him to diligence; his natural faculties, which were good, began to unfold themselves; he now entered fairly and heartily on the career of improvement, and very soon became an excellent scholar, rising superior, in some points, to the very ablest of his competitors, and disappointing all the fears which his previous carelessness had created. In his 12th year he was at the head of Bury school. Besides being a proficient in Greek and Latin, he had turned his attention to English poetry wrote verses that might have done honour to a riper age, and even produced a drama entitled *Shakespeare in the Shades,* composed, indeed, almost wholly of passages from that great writer, whom his mother had taught him to relish and to reverence, but put together with wonderful ingenuity and skill.

From Bury he was transplanted to Westminster school, then taught by Doctor Nichols, under whose tuition he advanced rapidly in classical attainments, not, however, without some aberrations of conduct; for on one occasion he left the Abbey in the time of divine service and joined a parcel of boys for the purpose of insulting the Quakers at their devotions; and on another, gave in to his master an exercise in Latin verse, every syllable of which he had stolen from Duport, and imposed upon the unsuspecting Doctor. He continued to court the muses, and at this time wrote a translation in blank verse of a part of Virgil's Georgics, which is not at all discreditable to his powers. He was also permitted to go sometimes to the theatre, where he had an opportunity of seeing Garrick, and of cultivating that taste for the drama with which his mother had first inspired him.

After spending two years at Westminster, he was admitted at Trinity College, Cambridge, where, though at first he had the misfortune to be put under the care of unfaithful tutors, and had nobody almost to direct and counsel him, he led a very regular and studious life; read poets, historians, philosophers, every thing that came in his way, with indiscriminating avidity; composed a little in English, but declaimed a great deal in Latin, of which language, in all its varieties, he was anxious to make himself completely master; mortified his body and endangered his health, that he might improve his mind; allowed himself only six hours sleep, and lived almost entirely on milk, while he gave himself to the study of mechanics, hydrostatics, optics, and astronomy, and those other branches of physical science, a profound knowledge of which was necessary to prepare him for passing through his academical trials with eclat; worked all his propositions, formed his minutes, and even thought and meditated in Latin, in consequence of which he acquired an extraordinary and enviable facility in expounding, solving, and arguing in that language; made such progress, that at the age of seventeen he *kept an act* against one whom he describes as a "blackbearded philosopher" and a "finished mathematician," and after a long and obstinate contest, defeated him, receiving unusually high compliments from the moderator who presided on the occasion; and at the end of a scrutiny peculiarly trying and severe, but terminating completely in his favour, he first took his *bachelors* degree, and then obtained a distinguished place among the *wranglers* of his year. The intense application by which these honours were gained, had nearly cost him his life; for six months he laboured under a rheumatic fever, which threatened to prove fatal; at length, however, by the skilfulness of his physician and the attention of his friends, he recovered from his indisposition, and was enabled to resume his studies. To restore his health, his father took him, along with the rest of the family, to reside in York. There he seems to have spent his time without pleasure and without improvement. He hunted in the morning, danced in the evening, wrote silly verses to employ his fancy, but did nothing that could either inform or invigorate his understanding. From this scene of trifling he was happy to escape, and hastened as soon as possible to college, where he had already acquired so much honour, and expected to gain still more by the continuance of his exertions. His natural dispositions, and the example of his ancestors, had directed his views to the clerical profession, and he was on the eve of obtaining a Fellowship in a manner the most creditable and advantageous, when a different path of life was opened to him, on which he entered without sufficient reflection, and on which he seems to have looked back at the end of his career with little else than feelings of bitter regret.

He received an invitation from Lord Halifax, then president of the Board of Trade, to whom his father had been useful during a canvass in Northamptonshire, to be his private confidential secretary. This invitation was not altogether welcome to himself, but his father and his friends, who anticipated nothing but prosperity and eminence, prevailed upon him to accept of it, and he accordingly plunged into the world of ceremony and politics, having his head full of Greek and Latin, his heart fixed on the college he had left, and little or no stomach for his new occupation. His principal study consisted in reading books upon the colonies, with which he was desired to acquaint himself; and the whole of his business, in copying a few private letters to civil officers abroad. All this, along with the inconveniences of London lodgings and London hours, did not prevent him from preparing, with his accustomed diligence, for the approaching election at Trinity College. His preparation was complete, and his efforts were successful. He had formidable rivals to contend with, and some prejudices in a higher quarter to encounter; but his abilities overcame all opposition, and after a difficult struggle, he obtained the Fellowship which had been the object of his ambition. This was an excellent opportunity for returning into the line of life which he had abandoned, but it is probable that the brilliant prospects which had dazzled his father, were now equally enchanting to the son; and he persevered in his course. He went back as soon as possible to his situation under Lord Halifax.

About this time he made his first literary offering to the press. It was a church-yard elegy, entitled *St Mark's Eve*, in imitation of Gray's, composed during some of his college vacations; but it excited little interest in the public, and procured as little gain to the publisher. As Lord Halifax wrote all his own dispatches, and as there was otherwise not a great deal of official duty for Mr Cumberland to perform, he betook himself to literature and the muses. He was bold enough to project a heroic poem on the History of India. But after having been at considerable pains in collecting materials for the work and making some progress in it, he desisted; and in this he acted wisely, if we may judge of the whole from the specimen he has given in his memoirs. Though he continued to read and write incessantly, yet he had leisure enough to reflect on his situation, to feel its dependance and its gloom, and to meditate a retreat. His father, however, removing to the vicarage of Fulham in his neighbourhood, and thus restoring him to those domestic enjoyments, the loss of which he had all along deeply regretted, he was prevented from taking that step; he remained in town during the hours of business, and spent the rest of his time at home. About a mile from Fulham, was La Trappe, the residence of the famous Bubb Doddington, to whom he was introduced, and with whom he became a frequent guest.

Lord Halifax having resigned his office in administration, and Mr Cumberland being ousted of course, he went to spend the summer at Eastbury, Mr Doddington's seat in Dorsetshire, where he saw a great many fashionable and amusing characters; and while he listened to the conversation, and admired the wit of others, did not forget to exhibit the powers of his own genius; having written a small poem, which was read by Mr Doddington to his company, and in which he attempted to console his patron on the event of his resignation, and complimented his host for his politeness and his politics. On his return from Dorsetshire, he offered himself as a candidate for a lay-fellowship, then vacant in Trinity college, and by the kindness of his friends he succeeded; but celibacy being an essential qualification for the place, he did not hold it long. It was about this time that he wrote his first dramatic piece. The subject, the Banishment of Cicero, was unfortunate for a tragic plot; the execution was not much better than the subject; and, accordingly, though strongly recommended by Lord Halifax, it was rejected by Garrick as unfit for representation. The publication of the play justified the refusal of Garrick, but did not prevent his Lordship from resenting it long and warmly.

In February 1759, having obtained a small establishment as crown agent for the province of Nova Scotia, he married the only daughter of George Ridge, Esq. of Kilmiston, in the county of Hants,—a young lady of great worth and beauty, by whom he had several children, and with whom he lived affectionately and happily. In the following year, upon the death of the king, Lord Halifax, who had previously re-assumed his office of First Lord of Trade, was appointed Lord-Lieutenant of Ireland, and Mr Cumberland went along with him to fill the post of Ulster Secretary. Before he set out, he wrote in blank verse, and published without his name, a poem on the King's accession, addressed to his Majesty, and containing the common-places about princely virtues, wise government, and public happiness. In Dublin Castle his situation was neither pleasing nor profitable. He was entrusted with the regulation of the Lord-Lieutenant's establishment; and, notwithstanding all his skill and economy, the expences were pushed by his lordship's pride and extravagance to L. 20,000, while there was only L. 12,000 to meet them. In his own subordinate sphere he himself was not much better. The fair income of his office was about L. 300 *per annum*, which came considerably short of his extraordinary expenditure; and his mind was too high or too honest to have recourse to the usual means of aggrandizing his fortune. He would accept of no gratuity which could be interpreted as a bribe; and had even the fortitude to refuse the rank of baronet, when it was offered by his patron as a mark of approbation. This refusal, however, contributed to weaken his interest with Lord Halifax, and to render successful the attempts of more complying and sycophantish competitors for favour. His lordship's change of sentiment and conduct towards him soon appeared; for when he received the seals of Secretary of State, he declined, on some idle pretence, to appoint Mr Cumberland to the place of Under Secretary, which he naturally expected, and respectfully applied for; so that for the sacrifice of all his original prospects, and the faithful and irksome services of ten or eleven years he held a place (that of crown agent for Nova Scotia) of only L. 200 a-year. His situation, however, was bettered by the kindness of the Earl of Hillsborough, First Lord of Trade and Plantations, who made him Clerk of the Reports, and thus secured him an additional annual revenue of L. 200. The duties of his new office were neither numerous nor burdensome, and left him abundance of leisure for his favourite studies. He produced an opera, called *The Summer's Tale*, of whose merit he himself entertained no high opinion; but which, on account of a few good songs inserted in it, with some original music furnished by Drs Arne and Arnold, and the vocal powers of the performers, had a run of nine or ten nights in moderate houses, and without opposition. It was purchased and published by Dodsley; and though he gave a liberal price, he did not complain of his bargain.

In the course of the summer Mr C. paid a visit to his father, who was now Bishop of Clonfert, in Ireland; and having returned to England in October, he produced, in the following winter, his first comedy, entitled the *Brothers*, at Covent Garden. It brought advantage to the theatre, and reputation to the author; and soem complimentary lines to Garrick, who was in the house the first night of the performance, introduced him to that celebrated actor, and laid the foundation of a lasting friendship. In the ensuing year, having paid another visit to his father at Clonfert, there, in a small unfurnished closet, with no avocations to call away his attention, with no interruptions to disturb his fancy, and with no prospect from his window but that of a turf-stack, he began to plan and compose his comedy of the *West Indian*, which immediately after his return to England he finished, and gave to Garrick, by whose assistance it had been improved, and under whose auspices it was ushered into life. Its popularity was deservedly great. It was performed with high applause for eight-and-twenty successive nights, and realised for the author a very handsome sum of money. His success encouraged him to go on in dramatic composition, and play after play came from him, perhaps with injudicious rapidity. He stepped aside, however, from this course, to vindicate the insulted memory of his grandfather Bentley, who had been attacked and abused in a pamphlet written by Bishop Lowth, which he did with some spirit and success, in a Letter addressed to that dignitary. The publication of the West Indian established Mr Cumberland's reputation; he was now accounted one of the most distinguished ornaments of English literature; his company was courted by men of taste and talents; he became a member of the famous club which was composed of Johnson, Reynolds, Burke, Goldsmith, M'Pherson, Garrick, and other eminent characters; and continued to enjoy their intimacy and respect. His comedy of the *Fashionable Lover* was very favourably received by the public. In point both of moral and of diction, it is perhaps superior to the *West Indian*, and at least supported the fame which this charming production had procured for him. The *Choleric Man*, another comedy, brought forward the following season, was not quite so popular as the three which preceded it, nor has it ever enjoyed the same eclat; it is, however, possessed of great merit, and reflects credit on the powers of its author. Having made a tour to the lakes in Cumberland in company with the Earl of Warwick, he took the opportunity of a few leisure days at Keswick, to write an irregular *Ode to the Sun*, which was published in 1776, along with another Ode addressed to Doctor James, by means of whose celebrated powders one of his children had recovered from a dangerous fever.

After writing several more plays, among which was the tragedy of the *Battle of Hastings*, that failed in exciting any interest, or in adding any thing either to his fortune or his fame, a brighter scene appeared to open upon him, in consequence of the death of Lord Halifax. Lord George Germain, who succeeded in the colonial department, promoted him to the secretaryship of the Board of Trade, and not only did this in the most friendly way, but shewed him every mark of kindness and attention. It is pleasant to observe, that Mr Cumberland's promotion seems to have gratified him, chiefly because it afforded him the means of giving a more ample and liberal education to his children, whose welfare was ever nearest to his heart, and who repaid his kindness by their affection and their duty. At the request of Lady Frances Burgoyne, he drew up the defence of the unfortunate Robert Perreau, which was adopted by his counsel Mr Dunning, and proved the means of saving the prisoner's life. So great indeed was his reputation at this time as a writer, that Dr Dodd applied to him for his good offices, which he would very readily have granted, had not the painful and hopeless task devolved on his friend Dr Johnson. It deserves to be recorded for the credit of Mr Cumberland, that it was chiefly, if not wholly, through his exertions, that Sir George B. Rodney received that naval command, which he executed with so much honour to himself, and so much advantage to the country. In 1780, he was sent on a private diplomatic mission to the court of Spain, in order to negociate a peace, for which he previously discovered there was a favourable opening. But the project failed. Whether the failure was owing to insincerity on the part of Spain, or to mismanagement on that of the British ministry, certain it is that Mr Cumberland did not receive the treatment to which he was entitled from his employers. The promises made to him before he set out were not fulfilled—his bills upon his bankers were dishonoured by the treasury—in consequence of this, he was arrested at Bayonne on his way home, by order from his remittancers at Madrid, while labouring under the violence of a fever—he had incurred so much expence, though abundantly economical, as to put him under the necessity of selling every acre of his hereditary estate, in order to liquidate his debts—all the applications that he made for remuneration and redress, were received with coldness, and treated with neglect—and there is reason to believe, that a long and interesting memorial which he addressed to Lord North, setting forth his grievances, and claiming relief, was never even honoured with a perusal;—that it produced no effect, is a melancholy and indisputable fact. On the overthrow of Lord North's administration, and the dismissal of the Board of Trade, under the regulations of Mr Burke's bill, Mr Cumberland was set adrift, having a compensation allotted to him, better indeed than what he received for his Spanish claims, but not amounting to more than a half of what was taken from him. Reduced by these unfortunate events to narrow circumstances, he put his family on a corresponding establishment, and took up his residence at Tunbridge Wells. Here he seems to have spent his time very agreeably, devoting himself as formerly to his books and his pen, and enjoying the society which the place and neighbourhood afforded.

Soon after his return to England, he published a work in two volumes, entitled, *Anecdotes of eminent Painters in Spain*, in which he communicated some curious and interesting information on a subject that was little known, and gave a catalogue of the paintings in the royal palace at Madrid, which the Spanish monarch permitted to be drawn out at his request, and transmitted to him after his return. Some time after, he produced the *Observer*, a collection of original essays on various topics, favourable to religion, morals, and literature. That part of it which gives a review of the literary age of Greece, and a history of the Athenian stage, is particularly valuable; it has received high encomiums from the most competent judges, and deserves the attention of every classical scholar. From the translations which it contained of the fragments of the Greek comic writers, the learned author of the Pursuits of Literature concluded, that Mr Cumberland was the only man in the kingdom equal to the translation of Aristophanes. The Observer, of which two editions were published in the two first years, extends now to six volumes, and is considered as a standard book. The next work of any consequence that Mr Cumberland attempted, was an epic poem in eight books on the death of Christ, and entitled *Calvary*. He began the composition of it in winter, and rising every morning some hours before day-light, soon completed it at the rate of more than fifty lines a day. It did not meet with a very favourable reception in the stately and expensive form of a quarto. The author complained of the ungrateful and unbrotherly neglect of his cotemporaries. He gave the king's librarian a copy to be laid at his majesty's feet; but it does not seem to have elicited one spark of royal favour. He was consoled, however, by anticipating the praises of posterity to a work of which his own opinion was sufficiently exalted. And, indeed, before he died, his publishers boldly ventured on a new edition, in a more portable size, and he had the happiness to know that *Calvary* was both purchased and admired beyond what he had allowed himself to expect. Amidst the various subjects which occupied Mr Cumberland's pen, that of religion was not neglected. He studied and he wrote upon it with good effect. His chief production in this way was entitled, a *Few Plain Reasons for Believing in the Evidences of the Christian Revelation*, a treatise which is tolerably well reasoned, and may be read with considerable profit.

When the volunteer system prevailed in the country, he stepped forward and gave his services for the public cause; first as major commandant, and then as lieutenant colonel, to which rank he was promoted, though he had not a single acre of ground in the county. He took great pleasure in drilling his men, who were much attached to him, and whose soldierlike conduct he has commended in his Memoirs. These *Memoirs* of himself were undertaken at the suggestion and request of some friends, who probably conceived that such a work might be a means of bettering his fortune. He began them at the close of the year 1804, finished them in September 1805, and published them immediately. A second edition was soon called for, and to this he added a supplement, for the purpose of stating facts which he had omitted to mention, and making some remarks on Mr Hayley, the Edinburgh reviewers, and others who had offended him by their animadversions. Mr Cumberland's Memoirs have been much read. They are highly entertaining and not uninstructive, contain a good deal of egotism, but more of benevolence, and abound in lively and most characteristic representations of the literary and political characters of his time. The copy right was sold by him for L. 500. He attempted another epic poem on another sacred subject. It was called the *Exodiad*, having for its subject the history of Moses from the period of his leading the Israelites out of Egypt, to his death upon Mount Horeb. He was assisted in it by Sir James Bland Burges, who drew out the plan, and took his share in the execution. The merits of this work are far from being eminent. The most unsuccessful, perhaps, of all Mr Cumberland's literary undertakings was the London Review, which was published quarterly, had superior pretensions to honesty and candour, and endeavoured to support these by annexing to every article the name of the critic who had written it. It very soon died, if indeed it could ever have been said to live. Without the awful and mysterious hypothesis of a tribunal of learned men, who solemnly deliberated upon the books reviewed, and labouring under the depressing influence of open and individual responsibility, it was destitute of spirit and of interest: tame and cautious in itself, and deriving no importance from the oracular wisdom of its authors, the public would have nothing to do with it; and accordingly it was soon given up as an unprofitable concern.

In the latter period of his life, Mr Cumberland endured a variety of afflictions. The loss of his wife, the bad health of his favourite daughter and of her husband, the disgrace unjustly inflicted on one of his grandsons on board a ship, the gradual disappearance of those who had been the companions of his youth and the friends of his maturer age, the failure of his literary pursuits, and the consequent pecuniary difficulties with which he had to struggle,—all these things bore heavy on his mind, and occasioned many a pang. Yet he bore his misfortunes with much patience, and was often chearful amidst them all. Even when he was thus situated, and had seen no fewer than fourscore years, the fire of poetical genius still burned with some degree of vigour. And however much it is to be regretted, that a more appropriate task did not occupy the last days of Mr Cumberland, than the composition of an indifferent play, yet such is the fact that he was actually engaged in completing the now unfinished drama of Demetrius, when death carried him off the stage of this world. He breathed his last, after a sudden and short illness, at the house of Mr Henry Fry, in Bedford Place, Russel Square, on the 7th of May 1811, in the 80th year of his age. A funeral procession took place, and his body was deposited in a spot nearly at an equal distance from the remains of Dryden and Addison.

The preceding account of Mr Cumberland has been drawn up from his own *Memoirs*, from the biographical sketches of him published after his decease, and from incidental notices which have occurred to us in the course of our reading. Our limits do not permit us to give a particular character of all the productions of his pen, but the following is a tolerably accurate list of them, so far as they have come to our knowledge.

I. Theology. 1. Sermons. 2. A Few Plain Reasons for believing in the Evidences of the Christian Revelation. 3. Fifty of the Psalms of David rendered into English metre.

II. Heroic Poetry. 1. Calvary, or the Death of Christ, in blank verse. 2. The Exodiad.

III. Dramatic Works published during his life. 1. The Banishment of Cicero, in 5 acts. 2. Caractacus. 3. The Summer's Tale, originally an opera, and then cut down into an after-piece of 2 acts. 4. The Brothers, a comedy. 5. The Fashionable Lover, a comedy. 6. The West Indian, a comedy. 7. The Choleric Man, a comedy. 8. Timon of Athens, altered from Shakespeare. 9. Note of Hand, or a Trip to Newmarket. 10. Mysterious Husband. 11. The Battle of Hastings, a tragedy. 12. Box Lobby Challenge, a comedy. 13. Calypso, an opera. 14. The Impostor, a comedy. 15. The Widow of Delphi, or Descent of the Deities, a comic opera. 16. False Impressions, a comedy. 17. The Carmelite, a tragedy. 18. The Natural Son, a comedy. 19. The Dependant. 20. Days of Yore. 21. Word for Nature. 22. First Love, a comedy. 23. The Jew, a comedy. 24. Country Attorney, a comedy. 25. The Arab, a tragedy. 26. Wat Tyler, a comic opera, objected to by the Lord Chamberlain, and new modelled and produced under the title of the Armourer. 27. The Clouds, translated from the Greek of Aristophanes, and incorporated into the 6 vol. edition of the Observer. 28. The Sailor's Daughter. 29. Wheel of Fortune, a comedy.

IV. Posthumous Dramatic Works in two volumes 8vo. Vol. I. contains the Sibyl, or the Elder Brutus, a tragedy. 2. The Walloons, a comedy. 3. The Confession. 4. The Passive Husband, a comedy. 5. Torrendal, a tragedy. 6. Lover's Resolutions. Vol. II. contains, 1. Alcanor, a tragedy. 2. The Eccentric Lover, a comedy. 3. Tiberius in Capreæ. 4. The Last of the Family, a comedy. 5. Don Pedro. 6. The False Demetrius, (unfinished).

V. Fugitive Pieces. 1. Verses on the King's Accession. 2. A Poem after the manner of Goldsmith's "Retaliation." 3. Verses on the bust of the present Prince of Wales. 4. An irregular Ode addressed to the Sun. 5. Ode to Dr Robert James. 6. Lines to the Earl of Mansfield. 7. St Mark's Eve, an elegy.—With a great number of small pieces which it is not worth while to detail.

VI. Novels. 1. Arundel, 2 vols. 2. John de Lancaster. 3. Henry, 4 vols.

VII. Controversial. 1. A Letter to the Bishop of Oxford, (in vindication of Dr Bentley.) 2. A Pamphlet on the Bishop of Llandaff's proposal for equalising the Revenues of the English Hierarchy.

VIII. Miscellaneous. 1. Curtius rescued from the Gulph. 2. A Sketch of Lord Sackville's character. 3. The Observer, 5 vols. 4. Anecdotes of eminent Painters in Spain, with a Catalogue of the Paintings in the King's Palace at Madrid. 5. Memoirs of Himself, 4to. and with a Supplement in 2 vols. 8vo. 6. Preface and Articles in Tipper's Review. (τ)

CUMINUM, a genus of plants of the class Pentandria, and order Digynia. See Botany, p. 165.

CUNILA, a genus of plants of the class Diandria, and order Monogynia. See Botany, p. 90.

CUNNINGHAMIA, a genus of plants of the class Tetrandria, and order Monogynia. See Botany, p. 120.

CUNONIA, a genus of plants of the class Decandria, and order Digynia. See Botany, p. 215.

CUPANIA, a genus of plants of the class Octandria, and order Monogynia. See Botany, p. 199.

CUPAR, a town of Scotland, in Fifeshire, is situated in the middle of the county, on the banks of the river Eden, at its junction with the Mary-burn. The ground in the immediate neighbourhood is alluvial, and elevated above the level of the sea about forty feet; but on the north and south it rises to a considerable height, and greatly circumscribes the view from the town. The fields along the banks of the Eden are often enveloped with mist, whose influence is pernicious to the potatoes in autumn, and to cabbages and other vegetables in winter. The town is but poorly supplied with water. There are few springs, and the wells dug in the argillaceous strata form *hard* water, highly impregnated with earthy salts.

The town consists of three streets, besides a number of lanes and detached buildings. The Crossgate, or principal street, runs from north to south, is broad, well-aired, and contains many substantial well-finished houses. Here the weekly markets are held, and here also are the best frequented inns. The Bonygate joins the north end of the Crossgate, and stretches to the west. It is a little narrower than the former street. The New-street, or St Catherine's, is nearly on a line with the Bonygate, joining its east end. It has been built according to a regular plan, and the houses are elegant and commodious.

The town of Cupar can boast of few interesting objects of antiquity. Its castle, of which no vestige remains, was once a place of considerable strength. In its neighbourhood, there was a convent of Dominican or Black Friars. On the high ground to the east of the town stood the church of St Michael. The steeple connected with the present church, is a very handsome building, and is a great ornament to the town. It was built, in part, by the prior of St Andrew's in 1415, and finished by Mr William Scot, who was for many years minister of Cupar, and who died in 1642.

The parish church is a very plain building, possessing no external decorations, unless we consider the porch as such, which was lately added. It is not sufficient for the accommodation of the inhabitants of the parish. The town-house contains chambers suited to the purpose of public meetings, but has a very mean exterior. The county-rooms, which were added to the town-house nearly thirty years ago, are now forsaken, more elegant accommodation being provided in the buildings in the New-street, for the noblemen and gentlemen of the shire to hold their public meetings, balls, &c. The plan for the new county-rooms was drawn by Mr Gillespie, and executed by subscription under the management of a truly patriotic magistrate, John Ferguson, Cupar Fife.

Esq. of St Catherine's, the present provost of the burgh. Adjoining to the county rooms, an inn has been built by tontine; and it was proposed to terminate the new street with the prison ordered for the town by a late act of Parliament. A plan was made of the prison, corresponding in style with the other buildings in the street. Objections were urged against the propriety of placing it so near the river, and at such a small elevation above it, suspicions being entertained that dampness would prevail and injure the health of those confined. The party who urged these objections soon forgot them, after they had frustrated the efforts of those who wished to make the public buildings of the town subservient to ornamental purposes. The prison is now erecting on the south side of the river, nearly upon its margin, a few feet higher than its banks, and several feet lower than the situation formerly proposed. With regard to the plan of the building, we have to regret that more pains have been taken to decorate the walls, than to make the cells either healthy or comfortable.

The inhabitants of the town are in general healthy, and frequently long-lived. Few instances of derangement or deformity occur. Their principal employment is the manufacture of linen. There are also manufactures of leather, candles, ropes, brick and tile. There are three branches of Edinburgh banks for the accommodation of the merchants: the Bank of Scotland, the British Linen Company, the Commercial Bank, together with the Fife Bank. The poor are well attended to, being supported by donations from the revenue of the burgh, and by voluntary contributions made at the doors of the church.

The church of Cupar is a collegiate charge, and its meetings are well attended. There are likewise meetings for Episcopals, Antiburghers, and those connected with the Relief.

The children of the town have good opportunities for receiving instruction, as there are excellent schools, under the patronage of the magistrates, and the inspection of the clergy. All the useful branches of education are taught with ability and success. There is a public library, well-stocked with books in various branches of literature and science. And we may mention, as connected with the literary history of the town, that the printing-office of Mr Tullis has produced editions of Horace, Sallust, Virgil, Cæsar, and Livy, revised by Dr John Hunter of St Andrew's, which, in point of typography, do great credit to the Cupar press.

Cupar is a royal burgh of very ancient date. It is governed by a provost, three bailies, a dean of guild, thirteen guild counsellors who choose one another, and eight trades counsellors or deacons, elected by the eight corporations. The revenue of the burgh is about L. 500 a year. Here a weekly market is held, and also seven fairs. Being the head burgh of the shire, the public business is here transacted, and the courts of law and taxation are held. Population of the town 4000. (J. F.)

Cupar Angus.

CUPAR, or COUPAR, generally called CUPAR-ANGUS, is the name of a town and parish in the county of Angus or Forfar. Before the Reformation, the parish of Cupar-Angus formed only a part of the parish of Bendochy, which lies about a mile to the northward, across the river Isla. Many years after its erection into a parish, the lairds of Kithock retained a servitude over it; every possessor of a farm and grass-house was obliged to pay a proportional quota of money or victual to their boatman, in name of freight, for transporting the people to the church of Bendochy. The parish is nearly five miles and a half long, and varies from one to two miles in breadth. It contains about 2500 acres. A narrow ridge runs along two thirds of the parish of a light gravelly soil; the rest, in general, appears to be loam or clay, and the neighbourhood of the town is full of vegetable mould. The greater part of the parish is enclosed, and the crops chiefly raised are wheat, barley, oats, turnips, and potatoes. Land rents from L. 2 to L. 7 per acre, but the latter sum is only given for land in the immediate vicinity of the town. There is one farm in the parish of 500 acres, but in general they run from 50 to 120 acres.

The town lies towards the west end of the parish, and contains, by the last return, 2100 inhabitants. They subsist chiefly from the profits of agriculture, though there is a considerable manufacture of coarse brown linen, to the extent, at present, of 200,000 yards per annum. The town is divided by a rivulet which rises about five miles to the south west, and discharges itself into the Isla, two miles and a half to the northwest. This rivulet forms the boundary between Perth and Forfar shires, as it runs through the town. Cupar-Angus was a Roman station during the expedition of Lolius Urbicus, according to Chalmers in his *Caledonia*. The east side of the camp appears to be pretty entire, and measures 400 yards in length. The south side was levelled about 30 years ago, and is now under tillage. The prætorium was about the centre of the camp, as it is the highest ground within it, and commands a view of the whole. On or near the site of the prætorium, was founded the abbey, by Malcolm IV. in 1164, the year before he died. It was erected at the request of Walthoef, abbot of Melrose, for monks of the Cistertian order. Boece says, that in his day they were remarkable for their pious and blameless lives. The abbey is completely demolished, except a small fragment, overgrown with ivy, which appears to have been a part of the south-west corner. The greater part of the town formerly was built of the stones which composed it; and the foundation is so completely defaced, that it is now extremely difficult, if not impossible, to trace the form of the building itself. The church must have been in the form of a cross; but if we might hazard a conjecture, the abbey formed three sides of a square, with cells around for the monks.

A steeple was built by subscription about fifty years ago, on the site of the regality prison; and, in 1767, the Earl of Moray, the proprietor of the abbey lands, presented the town with a bell, which was placed in it.

The town lies about twelve miles and a half northeast from Perth, and fourteen and a half north-west from Dundee, near the middle of the estate of Strathmore. The whole of the parish, except the lands belonging to the Hon. Archibald Stuart, son of the late Earl of Moray, about 130 acres, lies in the county of Perth.

The following is the population of the parish at four different periods:

1755	1491
1793	2076
1801	2416
1811	2590

The population of the town in 1801 was 1960, and in 1811, as already stated, 2100. *

* The Editor has been indebted for the valuable information contained in this article, to the Rev. Mr HALKETT, Minister of Cupar.

CUPELLATION. See Essaying.

CUPHEA, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 224.

CUPPING. See Surgery.

CUPRESSUS, a genus of plants of the class Monœcia, and order Monodelphia. See Botany, p. 328.

CURACOA, or Curassou, one of the West Indian islands. It is situated in the Caribbean sea, to the north of Terra Firma, and of the province of Venezuela, from the coast of which province it is not more than twenty leagues distant. This island lies in latitude between 12° and 13° north, and in longitude between 60° and 70° west. It is in itself little more than a bare rock, extending from nine to ten leagues in length, and somewhat more than three in breadth. It produces some sugar, tobacco, wool, and leather. It is comparatively of little consequence, however, in respect of cultivation or pasturage; it derives its importance altogether from its subserviency to commerce.

When the Portuguese recovered from the Dutch that part of Brazil which had been originally taken from them, the republic of Holland would have lost all footing in the new world, but for a few small islands which they still had in possession, particularly this of Curaçoa. That island had been held by the Spaniards since 1527; from them it was taken by the Dutch in 1632. What principally induced the Dutch to undertake this conquest, was a desire to procure for themselves the facilities which it would afford for the prosecution of an illicit trade with the Spanish main. It was, besides, in the vicinity of the island of Jamaica towards the north, of St Domingo on the north-east, and of the smaller Antilles towards the east, in all of which directions accordingly it was yet farther practicable to prosecute a gainful commerce. Soon after the period alluded to, crowds of Dutch ships, strongly built and well armed, were seen pouring into the island, where they were in the practice of touching either for intelligence or for pilots, and then to proceed chiefly to the Spanish coasts with a view to trade. This they were able to force with a strong hand, being not only armed but even manned with choice men, whose bravery was animated by the interest which they had individually in the success of their operations. They had each one of themselves a more or less considerable share in the cargoes on board, which it was therefore their resolution to defend at the hazard of their lives against all attacks of the *guarda-costas*. In progress of time, some change took place in the manner of conducting this forbidden intercourse. Curaçoa itself became an immense magazine, to which the Spaniards came in their boats with the view of exchanging their gold, their silver, their vanilla, their cacao, their cochineal, their bark, their leather, their mules, for negroes, linen and woollen cloths, silks, India stuffs, spiceries, laces, ribbons, quick-silver, articles of iron and steel, or whatever other commodities were brought into the numerous storehouses formed within this island, either from Europe or the East Indies, or any other parts of the world. In this traffic, the Dutchman had the advantage of disposing of great quantities of various sorts of goods, which were the mere refuse of warehouses and mercers shops, and which had grown unfashionable, and therefore unsaleable every where else. Though vessels were, in the manner alluded to, constantly passing from the Spanish coast and returning, this did not prevent the Dutch vessels from proceeding to the creeks and bays of the Spanish coast. There was a reciprocal feeling of wants, a mutual contribution of labour and of exertions for supplying them, which produced a just degree of activity around these shores. It seemed as if there were an actual competition on foot between nations, rivals in commerce, and equally covetous of wealth. The substitution of register-ships in place of the galeons, caused afterwards some relaxation in this twofold communication; but it may be expected, that it will always revive when the state of foreign relations is in any respect such as to prevent the direct supply of the Spanish coast with those articles of provision that are indispensible to it.

The trade of Curaçoa, even in times of peace, was said to be annually worth no less than £500,000; but in time of war the profit was still greater, for then it becomes the common emporium of the West Indies, affording a retreat to ships of all nations, and at the same time refusing to none of them arms and ammunition for their mutual destruction. The intercourse with Spain being at such times interrupted, the Spanish colonies have scarcely any other market whence they can be well supplied either with slaves or goods. The French came hither to buy the beef, pork, corn, flour, and lumber which were brought from the continent of North America, or exported from Ireland. And besides the other articles of its own native produce, the salt works of the island, which are good and valuable, afford a considerable supply of this article to the English islands and the colonies on the continent.

It was in ships from Curaçoa, together with those of Carthagena and Porto-Bello, that almost all the negroes that were sent to Peru used formerly to be conveyed to it. This was a very considerable branch of traffic, the Spaniards often taking off not less than 1500 slaves at a time. This trade has diminished from the period that the English settlers in Jamaica took part in it; and were allowed, so to speak, to do it publicly; but a compensation was found in the traffic which succeeded in European goods. It is impossible to estimate the quantity of goods of this description, which, though contraband, the two towns just named carried off every year from Curaçoa, or which the Hollanders themselves distributed throughout the opposite coast of Venezuela, as well as in the river Hache and in New Andalusia. The sugar prepared in Curaçoa, and the tobacco grown there, as well as the wool, leather, and other produce of the island itself, made one part of the cargoes which were taken in return by the ships that brought those commodities when setting out again for Europe. These, however, would have afforded no adequate inducement to draw thither the number of ships that used annually to visit this island; and its trade must have quickly come to an end, had not the rich merchandize of Spanish America abundantly compensated the pains that were thus taken for furnishing the magazines of the island with an ample and constant supply of European goods. This traffic, so sure and so rich, has been, for the most part, carried on in five or six large vessels, which were constantly at sea, and in progress from one coast to the other; those concerned in the management of it being so well aware of its importance, that no more time was allowed on any occasion for remaining in port than while the vessels were unloading and taking in the fresh cargoes, which were always in readiness for them at the island.

In consequence of the lucrative traffic which thus originated between the Dutch settlers of Curaçoa and the Spaniards, it became the policy of the former to

Curaçoa. prevent the ships of adventurers from entering into their ports, and to refuse purchasing the booty which those determined pirates drew from the Spanish nation. This apparent misunderstanding with the freebooters, was not, however, in any respect really prejudicial to the interests of the merchants of the island; for when an opportunity offered, the vessels of the pirates were dispatched to St Thomas's, a Danish settlement, whither they were followed by ships provided with money or goods, with which to purchase, or to receive in way of barter, their illicit cargoes.

Curaçoa has been accustomed, especially in times of war between Great Britain and France, to supply all the southern coast of St Domingo with provisions. It at the same time took off the produce of that island, which, even at the state of improvement to which the colony, while in possession of the French, had advanced, could not but be very considerable. French armed vessels from the windward islands, regardless of the length of the passage, went thither in crowds during the continuance of war, because they could there find every thing necessary for the equipment of their vessels, often the commodities of the Spanish main, always those of Europe, which are in these parts in universal use. English privateers but rarely appear in those seas.

The trade between Curaçoa and St Domingo afterwards fell greatly off, in consequence as well of the supplies which the latter island obtained from other parts, as of the commotions which arose in it. Every commodity, without exception, landed at Curaçoa, while it remained in possession of the Dutch, paid one per cent. port duty. Dutch goods were never taxed higher, but those shipped from other European ports paid nine per cent. more. Foreign coffee was subjected to the same tax, with the view of promoting the sale of that of Surinam. Every other American product was subject only to the payment of three per cent. but with the express stipulation, that it was to be conveyed directly to some part of the republic. The Dutch Company trading to the Indies never itself engaged in any commerce at Curaçoa, but was contented with the duties accruing from whatever was brought into the island. The caprice of those appointed to the collection of these taxes, was too much made the measure of their amount, foreigners of course being always those who were most molested. The various civil officers whom, for this or other purposes, the company maintained here, were very ill organised in respect to the maintenance of the interests of individuals, but they were specially charged to look after those of their employers. The principal, and the highest in credit of these officers, was the fiscal, who at the same time was sole notary of the island, and registered all public acts.

It has been of much consequence for the commerce of Curaçoa, that it has an excellent harbour. Indeed it has two considerable ports, one on the south part of the island and at its western extremity, called St Barbara, the other, and the principal one, three leagues to the south-east of its most northern parts. To this large and excellent harbour the access is, indeed, somewhat difficult, but when once it has been entered its spacious basin affords every convenience and security. It is capable of containing and protecting against all winds, as well as against any hostile force, upwards of 300 ships of the largest size. Any repairs can be conveniently made in it, so that a fleet defeated at sea may find here at once a safe asylum and conveniences for refitting. In the time of war, it is well adapted to serve as a rendezvous for merchant vessels bound to Europe, which, from its situation to windward, may always take refuge in it. It is an excellent station for provisions. In the war of 1780, cruisers from this island greatly annoyed the English West India trade, and with such advantage to themselves, that there was a balance accounted for by the treasury of about 190,000 francs (about £17,275 sterling,) arising from the duties on the prize-cargoes. Those proceeds had been invested on mortgage for the benefit of the company. The port last mentioned is defended by a fortress, skilfully constructed and constantly upheld in proper condition.

Curaçoa, offering in some respects but little temptation to enemies, has been sufficiently exempt from hostile attacks. In 1673, the French having corrupted the commandant of the island, landed on it to the amount of 500 or 600 men. The treason, however, having been discovered, and the traitors punished, the invading troops were obliged to reimbark, without having met with the success that they expected. About five years afterwards, Louis XIV. whose pride had been hurt by this check to his conquering arms, sent out D'Estrees with 18 ships of war and 12 buccaneering vessels to wipe off the stain. But, from the rashness and obstinacy of the admiral, these vessels, when not far from their place of destination, were run aground on Davis's island; and the shattered remains of the fleet having been collected, returned in very bad condition to Brest, without having effected any thing. For a long time after that period, neither Curaçoa, nor the little islands of Aruba and Bonaire, dependant on it, suffered any disturbance.

It was necessary, as a traveller remarks, that one should have been a Dutchman, to think of settling there. Through the industry of the Dutch, however, not only were the advantages indicated which this place might afford in respect of trade, but the face of the country itself was so much improved as to make it, even in that point of view, not altogether undesirable. Through their exertions, the pastures, which formerly furnished a great number of cattle, were converted into plantations for sugar and tobacco; and a soil naturally barren, rendered in a variety of respects productive. In these circumstances, it has, at periods comparatively recent, again attracted the notice of enemies. It was captured by the English in 1798, and afterwards in 1806, by Captain Brisbane, who had upon the occasion three frigates only under his command. The official value of the imports and exports of the island under its new masters was, in 1809, imports L. 241,675, exports L. 316,696; in 1810, L. 236,181 imports, and exports L. 263,996. The principal articles imported from, or by way of, it into Great Britain, were coffee, sugar, rum, and cotton-wool. The following Table contains a list of the principal articles imported into Great Britain during the years 1809 and 1810.

	Coffee.		Sugar.		Rum.	Cotton Wool.
	British Plant.	Foreign Plant.	British Plant.	Foreign Plant		
	Cwt.	Cwt.	Cwt.		Gallons.	lbs.
1809	205	24,481	2	—	106	427,268
1810	700	29,466	—	—	24	230,770

Curaçoa. The principal towns of Curaçoa are one of the same name, and Williamstadt. The city of Curaçoa is well situated; its buildings are large, convenient, and magnificent; it is full of store-houses and shops, well provided with every species of merchandize, and of all kinds of manufactories. In its port, which, though dangerous and difficult to be made, is abundantly secure, vessels from all parts are continually lying. There is something also done here in the ship-building trade. The entrance to the port is defended by a castle, which, with the city, was in 1714 bombarded, but without success, by the French under the command of M. Caissar. The commanding ship of his squadron was wrecked upon the coast. There is in the city a synagogue for the conveniency of the many Jews by whom it is inhabited, and who are the principal merchants.

In Williamstad, which is considered to be the chief town of the island, or on the opposite side of the harbour, there are scarcely any white inhabitants besides a few merchants. Such as have any lands live upon them, and the public officers and servants of the company live in or near the fort. Houses are built so close to the walls of this fort, that a ladder from the upper stories would be sufficient to get within the walls. A remarkable blunder, also, of the engineer is noticed, who, in building a stone battery, turned the embrasures inwards instead of outwards; while in the front of that battery, which is intended to command the entrance of the harbour, there has been built a range of warehouses, which are not only themselves exposed to the fire of an enemy, but so impede the use of the guns of the fort, that it would be necessary to level them to a certain height before its shot could reach a hostile force. The powder-magazine also was placed at a distance from the fort, and in such a situation as to expose the road or access to it to the fire of any ship coming round on that side. The town, harbour, and fort, might, however, by the use of proper precautions, be rendered in a great measure impregnable to any attacks either by land or from the sea. The inhabitants of Williamstad are a mixture of Jews, Spaniards, sailors, free mulattoes, free negroes, Musquito and other Indians. The native population is become extinct, with the exception of three or four aged people at Curaçoa, and a few persons residing at Bonaire; while of whites, there are hardly half a dozen families who have not intermarried with Indians or negroes on the intermediate coasts. The religious houses of this city are a Dutch reformed church, a Lutheran church, a Roman-catholic chapel, and a Jewish synagogue.

A great deal has been said of the vices, and the disorderly manner of living, which, at former periods, are stated to have been in an extreme degree prevalent at Curaçoa. To the Jews who traded in it were attributed all the rapacity and bad faith, which, in any other instance, have been alleged to be characteristic of this people. The trade of the island in general, it has been represented, was a frightful tissue of piracy and pillaging: while manners were on a similar footing as commerce; libertinism, debauchery, robberies, murders, assassinations, being under no restraint, and no such thing as either justice or any regular system of police known. No respect or deference was paid to any authority subsisting on the island, military, civil, or ecclesiastical. The only formality of marriages was a certificate given by the public notary, and which stood at once instead of civil convention, and of nuptial benediction. The excesses of debauchery, it has been added, to which the people of this island gave way were such, that it was well for them that the air which they there breathed was not of that insalubrious character that it might appear to be, and had sometimes been represented: had the case been otherwise, it must soon have been entirely depopulated. The licentiousness of the negro slaves, owing to various causes, was in full proportion to that of the other parts of the community; while in their case there was a farther and a peculiar subjection to suffering. In the event of a scarcity of provisions, the distress of course fell chiefly on them; and in respect of the absurd principle adopted as to their manumission, which was that of a small fine being paid by the proprietors to government for their emancipation, generally when they were too old to work, they must then either obtain a precarious subsistence by begging, or be exposed to perish from want. See Peuchet's *Dictionnaire de la Geog. Commerçante.* Raynal's *History of the East and West Indies. Voyages interessans dans differentes Colonies Franc. Espagn. Angl.* &c. Thomson's *Alcedo*, vol. i. *Descript. de l'Isle de Curaçoa*, &c. (K)

Curatella || Curdistan.

CURATELLA, a genus of plants of the class Polyandria, and order Digynia. See BOTANY, p. 237.

CURCULIGO, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 186.

CURCULIO. See ENTOMOLOGY.

CURCUMA, a genus of plants of the class Monandria, and order Monogynia. See BOTANY, p. 81.

CURD. See DAIRY.

CURDISTAN, or KURDISTAN, a country of Asia, comprehending the whole of Assyria Proper, with part of Armenia and Media. In a general view, this country may be considered as bounded on the east by the mountain Coatrus and the river Surokh, which separates it from Irak, Azerbijan, and other parts of Persia; on the west by the Tigris, which divides it from Mesopotamia and Chaldea; on the south by Irak, and on the north by Turcomania. Towards the south it is narrow, scarcely exceeding 100 miles in breadth; but northwards it stretches near 500 miles, from east to west, *i. e.* from the 39th to the 47th degree of east longitude; and from north to south it reaches from about 34° or 35° to from 37° or 38° north latitude. The limits of this country do not appear, however, to have been very precisely ascertained. Indeed, tribes of the people called Curds are found widely dispersed over many parts of the empires both of Turkey and of Persia. They are met with in the Persian provinces of Khorassan and Armenia, as well as Ardelan and the pachalick of Bagdad, and dispersed also in the Diarbekr, and over the plains of Arzroum, Erivan, Sivas, Aleppo, and Damascus. They have been gradually extending themselves over the Lower Asia, and in other directions, particularly within these last hundred years; great numbers, as is alleged, of tribes and families having been detached from the nation, in consequence of the disputes inseparable from the anarchical state of their feudal government, in which each village, it is said, had its chief, and the whole country was parcelled out among a number of different and independent factions. There are, however, two principal and well recognised portions of territory which enter into the description of Curdistan, namely, the Lower Curdistan, or that portion of the pachalick of Bagdad which is situated beyond the Tigris, and which corresponds nearly to the whole of ancient Assyria Proper; and the province of Ardelan, which forms the eastern division of it. The first of these extends from Armenia, and the territories of the chief of Julamerick, to

Limits.

the district of Mendeli, which is its frontier towards Kuzistan. It is surrounded on the north and east by lofty mountains, and is divided into the districts of Solymania, Kerkook, Erbille, Amadia, Shahre-van, Zohaub, Bedri, and Mendeli; each of which has its separate hakem or governor. The province of Ardelan is in length 200 miles, extending from the little river Sharook to the Turkish district of Zohaub; and nearly 160 miles in breadth. It is divided from the plain of Hamadan by a small range of hills; and its western boundary is 100 miles beyond Senna, the capital, which has been ascertained by actual observation to be situated in latitude 35° 12′ north, and longitude 40° east.

General aspect.

The face of the country is different in different parts. That portion of it which lies to the north of the Little Zab being every where well watered and happy, in a fertile soil, has been in all ages particularly productive. It still continues to supply Bagdad, Mosul, and other cities in that quarter, with corn, cattle, cheese, butter, dried fruits, and almost every other kind of provision. The same character, as to fruitfulness, which belongs to this division, is, though perhaps in an inferior degree, pretty generally applicable to the whole of the province of the Lower Curdistan. That part of it to the north of Tooz Khoorma, a small town situated on the road to Mosul, at the distance of about forty-five leagues from Bagdad, has a flourishing and picturesque appearance, being covered with towns, villages, and gardens of fruit trees, and is in a highly improved state of cultivation. In the division of it lying to the south-east of Tooz Khoorma, the soil is more of a sandy nature, and the heat is more intense; consequently in this part the produce is less considerable, and the population proportionably scanty. Here, as well as in the Jezira, the cultivation is confined to the environs of the villages, which are thinly scattered over the surface of a naked plain. In the district extending from Sarakpoola to Solymania, nothing is to be seen but rugged and stupendous mountains, crowned with forests of stunted oak. In the province of Ardelan, the face of the country from the little river Sharook, by which it is separated from Arzerbijan, to Senna, is pretty uniform; and, indeed, it continues to retain the same character as far as to Kella Shah Khanee. It presents to the view either progressive clusters of hills, heaped as it were upon each other, or great table lands, covered with flocks and the tents of the Illiats, who pass the months of June, July, and August in this quarter, and in the winter remove to the neighbourhood of Bagdad. The intervening vallies, or rather glens, are narrow stripes at the foot of the mountains, where the villages are commonly built in situations proper for the protection of the inhabitants from the inclemency of the weather. These, however, are but few in number, as the Curds for the most part prefer a pastoral, and consequently a wandering life. For the same reason they content themselves with raising so much grain as is absolutely necessary for their subsistence. The soil, notwithstanding, is good, and might be made to yield abundance of wheat and barley. The oil plant is every where common here. Tobacco is cultivated in small quantities; and the mountains to the west of Senna are covered with forests of the finest oaks.

Rivers.

The principal rivers of the province of the Lower Curdistan, are the Diala, Great Zab, Little Zab, and Odorneh. The different branches of the Tigris also issuing from the mountains of this country, and surrounding the upper part of the Great Zab, pass on thence to the southward as far as the frontiers of the Irak-Adjemi, or Persian Irak. The Diala, rising in the mountains behind Solymania, whence it takes a southerly course, receives in its progress the tribute of a vast number of smaller streams. At about six or seven miles to the north of Kuzil Roobat, it unites with a river almost equal to itself in size, of which the source is at the foot of the pass of Kurren. Having now become a fine river, it still continues to proceed southward till it enters the Tigris, about five miles above Tauke Kesra. During the summer, the Diala is fordable at Bakooba, nine leagues from Bagdad, on the road to Kermanshaw. Just before it approaches the Tigris, it is near 150 yards wide; at which place a bridge of boats is thrown across it for the convenience of travellers. In the same range of hills with those of the Diala, and contiguous to them, are the sources of the Great Zab, the Zabatus of Xenophon, and Lycus of Ptolemy. This river at first pursues a northerly course, but after meeting with a small stream which comes from the district of Alhak, it proceeds in a westerly direction, unites with the Hakiar, or river of Julamerick, and then flowing towards the south-west, forms a junction with the Hazir Su, the ancient Bumadus, and disembogues into the Tigris at Toprukala, fourteen furlongs below Mozul. Between this place and Erbille the Great Zab can be forded only in the summer, and even then not without difficulty. The Little Zab is formed by the junction of a great number of little brooks, which originate in the hilly country to the east of Khoi Sindjack. It joins the Altun Su, or Golden Water, at Altun Kupri, which is sixty-eight furlongs distant from Bagdad, on the way to Mosul; and it terminates in the Tigris, at the village of Senn, thirty miles below Haditha. This is a narrow, but deep and rapid river. It is the same that was known to the Macedonians under the names Zabus Minor and Caprus. The Odorneh is, in like manner, formed from the union of several smaller streams, which have their rise in the hills between Kerkook and Solymania. It proceeds in a south-west direction, and falls into the Tigris twenty furlongs above Bagdad. At the village of Tooz Khoorma, above mentioned, the bed of the river is about sixty yards in breadth, and in spring it contains a great body of water.

Towns.

In Curdistan there are several considerable towns and hamlets. The largest of the towns of Lower Curdistan is Kerkook, which is situated in 35° 29′ north latitude. It lies in the direct road from Bagdad to Mosul, being at the distance from the former of 59 fursungs, and 41 from the latter. It stands on a commanding eminence, nearly perpendicular on all sides, below which is an extensive suburb. This city is defended by a mud wall, has 2 gates, 7 mosques, 14 coffee-houses, 1 hummum, 1 caravansera, 1 Armenian church, and 12 pieces of useless artillery mounted on the bastions. In the suburbs are 5 mosques, 9 small caravanseras, 13 coffee-houses, 3 convents, and 3 Catholic churches. The streets of the town are narrow and filthy, and the houses very mean. The population has been estimated at 18,000 souls, Turks, Armenians, Nestorians, and Curds; but this estimate is probably considerably beyond the truth. The country around the town is uneven and hilly; and on the north side, a low range of barren and rocky mountains separate the district of Kerkook from the fine plain of Altun Kupri. Kerkook appears to have been formerly a Roman station, and from the nature of the ground on which it stands, it still retains, when viewed from a distance, the appearance of a Roman fortress. It is the same town which is entitled

Curdistan. Towns.

Demetrias, by Strabo and by Ptolemy Corcura. Eighteen leagues to the eastward of this city is the town of Solymania a Shehr e Zour, which, in the retreat of Heraclius, is distinguished by the name Siazuros. Shehr e Zour having fallen into decay, was some years since rebuilt by Solyman the Great, pacha of Bagdad, and thus it received from him its present name. It is situated in a delightful country, close to the foot of Mount Zagros, and contains about 6000 inhabitants. It is the residence of Solyman, pacha of Curdistan, a distinguished warrior, who in 1810, at the instigation of the Porte, took arms against his master the pacha of Bagdad, whom he defeated, and put to death. The haken, or governor, who resides here, and who usually assumes this title just mentioned, must be by birth a Curd. He has the chief and most extensive of all the commands in the province. Not far from Solymania was the city of Holwan, the retreat of Yezdejird, after the battle of Cadesia, and to which the caliphs of Bagdad were accustomed to retreat during the heat of summer. It was ruined by Holaku, and has never since recovered its consequence. About 12 fursungs to the north-east of Altun Kupri, is the town of Khoi Sindjack, which, for many years, was the residenee of a pacha. Erbille though at present a wretched mud town, with a population not exceeding 3000 souls, appears to have been the Arbela so famous in history, for the final victory obtained by Alexander over Darius, and the capital of the province of Adiabene. Part of this town is built on a hill of a conical form, on which probably stood the old castle, and the remainder of it encircles the base of the hill. The country around it, and all along to Mosul, is fruitful, but hilly, and very deficient in wood, there being hardly to be seen here a tree, or even so much as a shrub. On the summit of a steep mountain, 18 fursungs north of Mosul, are the fort and town of Amadia, to which the only ascent is by a narrow flight of steps hewn out of the side of the rock. This city, as well as the province of the same name in which it is situated, are nominally subject to the pacha of Bagdad. But the Turks obtain no tribute from this province, which is in fact independent, and has continued subject only to its own native chieftains from the days of the Abassides. Exclusive of the dependent villages with which the place at the foot of the hill is every where studded, the town of Amadia does not contain above 600 houses. Shahr e Van, the ancient Apollonia, is peopled by about 4000 Curds and Turks, and is upon the whole a handsome little town, watered by two canals drawn from the Diala. Zohaub is in the same quarter, being like it situated on the high road from Bagdad to Hamadar. Mendali is about the same size as Solymania. It is surrounded by a number of fine gardens. The same is the case as to Bedri, which is the frontier town in this quarter of the Turkish empire. It is not quite so large as Mendeli, and the districts around it are damp and marshy, being interspersed with pools of water, the receptacles of the torrents, which in the spring continually rush from the adjacent mountains. Within the territories of Ardelan, secluded in a deep valley, which is well cultivated, and interspersed with orchards of peach, apricot, pear, apple, and cherry trees, Senna is at once a highly romantic and very flourishing little town. Besides about 2000 Jews, Armenians, and Nestorians, who reside here, and who trade to Mosul, Bagdad, and Ispahan, the population of the place may amount to about 6000 souls. The Wallee, who seldom quits it, resides in a sumptuous palace, built on the top of a small hill in the centre of the town, where he maintains a high degree of state and splendour, joined with the most liberal spirit of hospitality. In addition to these towns, Curdistan, in its largest sense, is understood likewise to comprehend Betlis, Scheresal, Harpel, Nineveh, Rehobo, Rhesen, and Van. Tribes also, or families of the Curdish race, form a considerable part of the population of Diarbekr, Mosul, Merdin, Palo, of Sok or Zog, which is governed by a powerful, independent, and hereditary prince, in the pachalick of Erzeroom in Armenia; and of the towns in Khorassan, subject to the similarly independent chief Meer Goonah Khan.

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State of agriculture.

The state of agriculture in Curdistan, differs in some respects from that which is most prevalent in the Persian dominions, water being in general so abundant as to prevent the necessity of irrigation. The grains most commonly raised in these parts are wheat and barley. Of the former there are two kinds, which are sown at three different seasons of the year. The first sowing takes place in March, and the crop is reaped in September; the second grain is sown in September, and reaped in July of the following year; and the last season of sowing is in October, of which the crop is reaped in the following August. When the second crop has attained the height of 7 or 8 inches, it is usual to turn in cattle to graze upon it for a certain period, after which it is permitted to acquire its proper maturity. This country is said to have been anciently reckoned more fertile than it is at present. It has been so much the seat of war, in former ages between the Parthians and Romans, and at a later period between the Turks and Persians, that it has been comparatively depopulated, and rendered waste and unproductive. It abounds with deserts, and except in the parts lying near to the towns, which are somewhat better cultivated, may be characterised as rather desolate and barren.

The Curds are brave and hospitable, but far more uncivilized than any of their neighbours. They are averse to settled habits. War and rapine are their delight, and murder and parricide they hardly consider in the light of crimes. They are robust, hardy, and temperate, and live to so great an age, that it is not uncommon to see men 100 years old in full possession both of their corporeal and mental faculties. But though stout and active, neither men nor women are at all agreeable in their persons, having very small eyes, wide mouths, bad complexions, very black hair, and a very fierce and forbidding aspect.

Tribes.

The tribes of Curdistan may be divided into two classes, consisting of such as live in tents, and of those who have more fixed habitations. The former, on the approach of winter, quit the more lofty regions, and retire gradually towards the warmer climate of the south. Here they remain during the cold weather, and return to their own country about April or May. They are often shifting their positions, in search of pasture for their numerous flocks and herds, and while the men are occupied with the care of these without doors, or roaming about in quest of plunder, the women employ themselves in making butter and cheese, and in training up the children to the mode of life in which they are to be afterwards engaged. The tents with which they accommodate themselves during their migrations are large and constructed, for temporary use, of cane hurdles, disposed in a square form, and covered with a sort of coarse brown cloth. The floors are matted, so as to answer at once the purposes of bed and board. When they are about to change their place, the huts are taken to pieces, and the oxen and cows loaded with them, and likewise

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Curdistan. with the children and household utensils. The men are generally well mounted, and take great care of their horses, of which there is here an admirable breed, much esteemed for their size, beauty, and activity. In the management of these, as in that of their arms, the Curds are understood to excel: their principal weapon is the lance. The women ride either on horses or on oxen. The children can suffer little in this migratory sort of life, being brought up very hardy, and accustomed to go almost naked even in the coldest weather. In some of the parts which have already received our more particular notice, there is to be observed somewhat of a more stationary manner of living. That division of the territories of Ardelan, which extends in the direction of Kella Shah Khanee, is peopled by a tribe named Gheshkee, who are honoured by the Curds as the most expert and daring robbers of their nation. That torture may not induce them to betray their accomplices, the people of this tribe are habituated to pain from their earliest infancy, being beaten so unmercifully when children, that their bodies, in course of time, become almost insensible to outward feeling. The rugged district of the Lower Curdistan, situated between Sarakpoola and Solymania, is also noted as the habitation of one of the most savage of the Curdish tribes.

Government. The Curds possessing a wild and inaccessible country, have never been completely subdued by any of the great neighbouring states, but continue to live under the rule of a number of independent princes, who govern their subjects as absolutely as either the King of Persia or the Grand Seignior. According to the account given of them by Niebuhr, who travelled in these countries in 1769, they are subject in their mountains to a sort of feudal government, similar to that whcih is observed among the Druses. They are for the most part tributaries, at least in appearance, to the Porte, but they pay little respect to the orders of the Sultan or of his deputies. The wandering tribes in the vicinity of Bayazid, Van, Khoonoos, Moosh, Betlis, &c. pay no tribute at all to the Turkish government; but in cases of emergency they furnish the pachas with certain bodies of horse, equipped and maintained at their own expence. The most powerful of the Curdish chiefs are the Wallees of Ardelan and Solymania, of whom the former, though he condescends for the preservation of peace, to pay an annual tribute to the king of Persia, is in all other respects completely independent. He has the power of life and death over his vassals, whom, however, he governs more as a patriarch than as a tyrant. He is said to be the lineal descendant and representative of the great Salahadeen, and holds his court at Senna, his capital, 60 miles from Hamadan, and 77 from Kermanshaw. The governor of Solymania holds in a similar manner of the pacha of Bagdad. At the period of the late troubles, so much was the usual order of authority set aside here, that a creature of the Curdish chief was advanced to the chair of his superior, which had been previously vacated in consequence, in a great measure, of his vigorous and spirited proceedings.

The Curds in their different tribes are proud of their descent, and fond of tracing the families of their chiefs to the most fabulous ages. In this respect they differ from their neighbours the Turkmans, also a wandering and pastoral people, who pay no respect to nobility or antiquity of extraction. Instead too, like them, of giving a portion with their daughters whom they bestow in marriage, they receive a premium for them. But what is to those in their vicinity the most offensive line of distinction between them and a people with whom in the main they agree as to their modes of life, is, that the Curds are every where considered to be addicted to theft and robbery. On this account they are much dreaded in the neighbourhood of Aleppo and Antioch, where, under the name of "Bagdashlia", they occupy the mountains to the East of Beelam, as far as near Kles, their number in this pachalic and in that of Damascus exceeding 20,000 tents and huts. Their tribes taken altogether are estimated to contain more than 140,000 men capable of bearing arms. Curdistan.

The Curds dress in a manner different from either the Persians or Turks. They speak also a language of their own. In this language there are three distinct dialects. It is said neither to have the aspirations or the gutturals of the Arabic, nor to resemble the Persian: in which case it is most probably an original language. Volney conjectures, that a knowledge of this tongue, considering the antiquity of the people by whom it is spoken, and that they are related to the Medes, Assyrians, Persians, and even the Parthians, might throw some light on the ancient history of these countries.

The state of the Curds, as to mental cultivation, is very deficient. They are seldom taught to read or write. In respect to religion, the majority of them are reputed to be Mahomedans of the Soone sect; but they trouble themselves little about religious opinions or rites. Several of them, distinguished by the name of Yardia, worship Shartan, or Satan, according to the ancient system of the good and evil principles, which has been so prevalent in the Diarbekr, and about the frontiers of Persia. There are among them also Armenians, Jacobites, and Nestorian Christians. Indeed every where throughout Curdistan, there are many towns and villages entirely inhabited by persons of the latter persuasion, who have their priests and bishops, and are in general an industrious people. The Gheshkee, though thieves and robbers by profession, are slaves to the most abject superstition. Of this the following is an example. There have been collected at Kella Shah Khanee the ruins of the castle of Shah Khan, a distinguished Ameer in the court of Chosroes Purviz, a few loose stones for the purpose of marking the abode of a *peer ghaib*, or invisible saint. On one of these stones it is usual, when any person belonging to the neighbouring tribes is unwell, to place a piece of bread steeped in oil or butter, with the view of propitiating the saint, and inducing him to recover the patient, which it is conceived in these circumstances he seldom fails to do. Education and religion.

There are among the Curds few of the means for the prosecution of any considerable commerce. The fine timber produced in the oak forests of Ardelan being made into rafts, is floated down the Zab into the Tigris. The gall-nuts, of which they likewise yield abundance, are, as an article of trade, exported to India. To the north of Kerkook, likewise, in the vicinity of Mendeli, there are naphtha pits, which yield an inexhaustible supply of that useful commodity. It is thence distributed over all the neighbouring country. This substance is an excellent substitute for pitch. The bottoms of most of the vessels which navigate the Euphrates and the Tigris are covered with it, and it is also used by the natives in their lamps instead of oil.

The circumstances and national character of the Curds appear to have undergone little change even from the remotest times. They are supposed to be the same people who are mentioned by Xenophon under the denomination of the Carduchai, and whom he states to

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have opposed the retreat of the ten thousand. This historian observes, that though shut in on all sides by the Persian empire, they had constantly braved the power of the great king, and the arms of his Satraps. The same, it will be perceived, continues to be still a pretty accurate account of their present condition. Their rude and barbarous customs have also remained without variation. The only considerable change, if that be not also more nominal than real, is in the article of religion. Volney takes notice of the similarity in sound between the names Curd and Gord, and thence suggests, that the original seats of the Curds may have been the Gordæan mountains, or the Gordonæi, where, according to the Chaldean Berosus, and the Armenian Maribas, cited by Moses Chorenensis, Xisuthrus landed, after escaping from the deluge. The Curds themselves still boast of being the direct descendants of Noah. See Niebuhr's *Travels*; Volney's *Travels*, vol. i.; and Kinneir's *Geographical Memoir of the Persian Empire*, passim. (K)

CURIATII. See Rome.

CURL. See *Potatoes* in Agriculture Index.

CURLING, the game of, is a winter amusement almost peculiar to Scotland. It is played by sliding stones along the ice to a particular mark, and has some resemblance to the games of *bowls* and *billiards*.

Stones employed.

The stones employed in it are of a spherical form, flattened above and below, so that their breadth may be nearly equal to twice their thickness. The upper and under surfaces are made parallel to one another, and the angles of both are rounded off. The under surface, or *sole* as it is called, is polished as nicely as possible, that the stone may move easily along. The blocks from which they are made are of whinstone, or granite, of a close texture, free from cracks, and capable of taking a fine polish. Those whinstone nodules, called *yolks*, on account of their toughness, and never breaking into large fragments, are reckoned the best. They have bent iron or wooden handles, and are from 30 to 60 lbs. avoirdupois weight, according to the strength of the person who uses them.

Rink.

The place where the stones move is called the *rink*, the chief property of which is that the ice be level, smooth, and free from cracks, particularly such as are in a longitudinal or oblique direction. A mark or hole is then made at each end called a *tee, toesee*, or *witter*. Round this two circles of different diameters are drawn, that the relative distances of the stones from it may be calculated at sight; as actual measurement is not permitted till the playing at each end be finished. These circles, in the technical language of the game, are called the *broughs*. A score drawn across the rink at each end, distant from the tee about a sixth part of the length of the rink, is called the *hogscore*. The length of the rink from tee to tee varies from thirty to fifty yards. The breadth is about 10 or 12 feet. When the ice is covered with snow, it must be cleared to that extent, and also ten or twelve feet beyond the tee, at each end, that the stones, when impelled with too much force, may have room to get far enough not to be of any use.

Number of players.

The number of players upon a rink is eight or sixteen; eight when the players use two stones each, and sixteen when they use one stone each. There may be one or more rinks according to the number of curlers. The game may also be conducted by one person against another, by two against two, or three against three, each using one or more stones, as it may be agreed upon.

He who is reckoned the best curler has generally the power of arranging the order of the players, and whoever is last in order, gives directions to all the rest of his party. He is called the *driver*, and the first the *lead*.

The method of conducting the game.

The game at first is remarkably simple. The lead endeavours to lay his stone as near the tee as possible. If it be a little short of it, upon the middle of the rink, it is reckoned to be fully better laid than if it touched it. The object of the next in order is nearly the same as that of the lead. The next attempts to guard the stone of his partner, if it be near the tee, or to strike off that of his antagonist if it be nearer. The one who follows, if a stone belonging to his own party lie nearest the tee, tries to guard it; if one of the opposite party, to strike it off; or if no stone be near the tee, *to draw a shot*, that is, to make his stone rest as near the tee as he can.

As the game advances, it becomes always the more intricate. Sometimes the stone nearest the tee, which is called the *winner*, is so guarded, that there is no possibility of getting at it directly. It then becomes necessary, in order to get it removed, to strike another lying at the side in an oblique direction. This is called wicking, and is one of the nicest parts of the game. But when the winner cannot be reached even in this way, the last in order but one or two must endeavour to remove the opposing stones, by striking them with great force. Sometimes the stones are so situated, that the driver, to avoid the risk of losing any shots which his party may have gained, throws away his stone without attempting any thing. When the stones on both sides have been all played, the one nearest the tee counts one; and if the second, third, fourth, &c. belong to the same side, all these count so many shots, thirty-one of which for each side is the number usually played for.

Its origin.

The origin of this game is yet involved in obscurity. While most of our national amusements are to be found recorded in the writings of the antiquary and historian, we find no mention made of this before the beginning of the seventeenth century. About that time, the allusions to it are such as clearly prove that it was then pretty generally practised. It is probable, however, that its origin does not go much farther back; because, if it had existed much earlier, it could hardly have been omitted in those lists which have been transmitted to us of the ancient amusements of our country. But in none of those lists do we find it ever mentioned, nor does any author make the least allusion to it previous to that period. In the statutes of the fifteenth century, we find a list of amusements, amongst which are golf and football, particularly prohibited by authority, in order to promote the noble art of archery, as it is called. But nowhere do we find a single hint about the game of curling. It can be practised, it is true, only for a short time in the winter; but when it is practised, it must, from its very nature, be public, and known to the whole neighbourhood. On which account, had it then existed, it could hardly have been overlooked by those who have particularly enumerated the Scotish amusements of the fifteenth and sixteenth centuries.

In later times, when it is known to have flourished in this country, we find it forming a favourite subject for poetic description. Not satisfied with allusions, the votaries of the muses have allotted to it whole poems, and expatiated with the feelings of a curler, upon the various circumstances connected with this *manly Scotish exercise*. Now, since we do not find it even mentioned

Curling.

before that time, it is highly probable that it did not then exist, or that it was only in its infancy.

The country where it originated.

Connected with this, is the inquiry respecting the country in which it originated. Upon this subject there are different opinions. Some seem to think that it was an amusement originally Scotish; others, that it was introduced into this country from the continent. The latter of these opinions appears to be best founded.

We have not been able, indeed, to find any direct evidence that it existed on the continent before it appeared in this country, but we have all the evidence which etymology can give in favour of its continental origin. The technical terms employed in it are all Dutch or German, and therefore point to the Low Countries as the place in which it most probably originated, or at least from whence it was conveyed to us. For if it was not introduced from the continent, but was first invented in this country, it must have been at a time when the German and Low Dutch were the prevailing languages. Now though the Saxon was once pretty common in this country, and there are still many Dutch words in our language, yet those German dialects were never so general, as to make it credible that our countrymen, in any particular invention, would employ them alone as the appropriate terms. In the history of inventions, such a phenomenon is not to be found. The origin of the game, then, is certainly continental.

But we have farther evidence that curling, or something like it, was originally practised on the continent. Kilian, in his Dictionary, renders the Teutonic *kluyten, kalluyten, ludere massis sive globis glaciatis, certare discis in equore glaciata.* Whatever those round masses of ice were, they seem to have been employed in a game on the ice resembling quoits. Indeed it is highly probable that the game which we now call curling, was originally nothing else than the game of quoits practised upon the ice. Besides, the game of curling was, till lately, hardly known by that name among the common people. From one end of Scotland to the other, it was always named *kuting,* to curl meaning nothing more than to slide upon the ice. The games are so similar, that the one might easily arise out of the other, and assume that form in which it at present exists.

Hence we conjecture that the game of curling was introduced into this country by the Flemings, in the fifteenth, or about the beginning of the sixteenth century. In the reigns of Henry V. and VI. of England, and James I. of Scotland, many of them came over to this country, which had been much depopulated during the destructive wars betwixt the two kingdoms, and settled in it as mechanics and manufacturers.

Its progress.

Curling is said to have been carried into Ireland by the Scotish colonies which were planted there so early as the reign of James I. of England. In that country, however, it seems now to be completely unknown. It has made its appearance in some of the northern counties of England, and has even found its way to the capital of the British empire. There the first essay was made upon the New River; but the crowd of spectators attracted by such a novel spectacle becoming very great, the ice threatened to give way, and the curlers were compelled to desist. It has not been confined within the boundaries of Europe; it has been carried over the Atlantic, and established in the frozen regions of North America, and particularly in the province of Canada. There, on account of the length and severity of the winter, it bids fair to attain a degree of celebrity unexampled in the milder climate of Scotland. In this country, it can be practised only a few days in the season, so few, that for the last twenty years the average number is not more than eight; while in that country, the amusement may be enjoyed during the greater part of the winter.

Currency.

Its character.

There are few amusements which excite more interest than the game of curling. In the severest weather, a good curler, while engaged in his favourite amusement, feels no cold. In playing himself, and assisting his partners with his broom, he finds sufficient exercise to keep him warm. And being performed at a time when the labours of the field are at a stand, and when several mechanical employments cannot be carried on, it gives little interruption to business. It brings men together in social intercourse; it enlarges and strengthens the ties of friendship, and enlivens the dreary hours of winter with festivity and happiness. It may therefore be regarded as one of the most healthy and innocent amusements that are practised in this country. (*u*)

CURRENCY, in commercial and money transactions, is a word of as general import as "circulating medium." It may be said, indeed, that all the extension given by political economists to the word "money," is applicable to its synonyme "currency," and that the cowries of India, philosophically speaking, come as much under the description of "currency" as our bank notes or our guineas. We shall confine ourselves, however, to the ordinary acceptations of the word, viz. metallic or paper money, and shall restrict the present notice to a portion only of the observations belonging to the subject of MONEY, reserving the remainder for the discussion which we intend to give under the latter title.

Metallic currency.

Metallic currency. The keenest advocates for the abolition of restraints on trade and manufacture, will not refuse to admit the necessity of a stamp being put on the coin by government, or by some association of undoubted responsibility. Without such a precaution, there would be no security for the weight or the fineness of the coin. Here, however, the interference of public authority should terminate. To affix to a specific coin any other denomination than a mere declaration of its weight, is an act of supererogation; attended too, as such acts generally are, with considerable inconvenience. To declare an ounce of silver worth five shillings, is, in fact, to say nothing more than that it is worth an ounce of silver. It is merely giving a new name to the same thing, the five shillings being useful for nothing more than the ounce of silver. With equal propriety, might government enact, that wheat, coffee, or chocolate should assume a new denomination as soon as they are divided respectively into bushels and pounds. We are led to dwell on this peculiarity, not by a wish to multiply theoretical distinctions, but by the perplexing irregularity attendant, particularly of late years, on the state of our money system. After all the discussions that have taken place on the bullion question, the majority of our countrymen are still at a loss to account for the remarkable difference between the market price and the coinage value of silver. Had our coins been known merely by their weight, had our crowns, for example, been nothing but ounces of silver, one material cause of perplexity would have been removed. Relatively to gold, silver might have fluctuated, as it is always liable to do, but no difference could have existed between silver in coin and in bullion, except that which might arise from their comparative fineness. In that case, it would have been clear, that the existing depreciation applies to our bank notes, and that it arises less from an over-issue of them, than from their being inapplicable to the purposes of foreign expenditure. In all cases of embarrassment, it is a main point to ascertain the source of the evil; an explanation of which paves the way for the adoption of the measures, frequently unpopular, which are requisite to effect a remedy.

The approximation, on this plan, to uniformity in price, would not be impeded by the plan of adding alloy to the coin. Gold or silver in bullion are not necessarily pure; on the contrary, these metals are, in every situation, more durable in consequence of the admixture of alloy.

Paper currency.

Paper currency seems the last refinement which it is possible to make in saving the expence of a circulating medium. It is, in fact, the exchanging the use of a commodity of great value for one of almost no value whatever. In the case of so decided a transformation, nothing, it is clear, can support credit except a thorough confidence that the article of value will be forthcoming on the presentation of its representative. It is, however, remarkable, that popular ardour, in certain circumstances, has given currency much longer than might have been expected to paper issues of a doubtful description. The grand period for obtaining circulation in this way, is the era of some remarkable revolution. The minds of men are then too much agitated by favourite anticipations, to dwell with coolness on the fate which must overtake the unchecked issue of paper. The war of 1775, on the part of the United States of America, and still more the French revolutionary war, are memorable instances of the length to which such fallacious emissions may be carried. Though used in the most lavish manner, their credit, in either case, lasted long enough to enable the respective governments to baffle all the efforts of their opponents.

In reverting to the memorable bubble of the Mississippi, it is due to the character of Law to mention, that he was not responsible for the monstrous abuse which was made of his views and projects. His ideas, as developed in his publication entitled *Considerations on Money and Trade*, imply a very different course from that which the French government thought proper to take. The bank founded by him in France in 1716, issued notes expressed in the following terms:

"The Bank promises to pay the Bearer at sight ——— livres, in money of the same weight and denomination as the *current money of the present date.*"

Such continued the form of the bank notes until 1719, and so far all went on well. But in that year the government of the Duke of Orleans thought proper to buy up the bank shares, and to give to this establishment the character of a government concern. It now received the name of *Banque Royale*, and the notes were expressed as follows:

"The Royal Bank promises to pay the Bearer at sight, ——— livres *in silver.*"

This change, slight as it apparently was, became a very serious matter in a country where government assumed the power of debasing the coin. It made the bank responsible, not for the coin current at the time of issue, but for its reduced value at a subsequent date. It was in vain that Law raised his voice against this innovation. Power got the better of argument, and, by a singular perversity, the faults resulting from an arbitrary exercise of authority were laid to the charge of erroneous principles. We have already expressed, under the head BULLION, our conviction, that the present depreciation of our bank paper exists chiefly in regard to foreign transactions. At home, the degree of depreciation appears to us comparatively small, and confined in its course to the operation of the enhancement of foreign articles. The wonder is, that, involved as we have been in a contest requiring such an amount of foreign expenditure, and with a bank restrained by no direct enactments in regard to its issues, the amount of our bank notes, and the consequent fall in their value, should not have been greater. The result is sufficient to shew, both the moderate views of the managers of the bank concerns, and the latent checks which exist in regard to a power of circulation apparently unbounded. The Bank of Ireland increased its issues with much more rapidity, after the exemption from cash payments, than her sister establishment. In France, on the other hand, the distrust attached to paper money since the ruinous days of the assignats, has put it out of the power of government, or of the Bank of Paris, to exceed a circulation of three or four millions sterling. Had it been otherwise, there can be no doubt that the French government, so far from imitating the prudence of ours, would have gone still farther in the course of over-issue and depreciation than the comparatively moderate cabinets of Austria and Sweden.

In the late discussions on the bullion question, the mercantile interest were almost unanimous in favour of the bank and of ministers. This arose, in a great measure, from an apprehension that the obligation to resume cash payments would necessitate a great reduction of the circulating medium, and would bring down on trading people all the evils attendant on scarcity of money. In the actual circumstances of the country, there can be no doubt that a sudden diminution of our circulating medium would have formed a severe aggravation of our previous embarrassments. But, speaking in a general way, there can be nothing less necessary or less politic, than to provide, by enactments of government; for the introduction of a circulating medium currency, we may take for granted, will never fail to provide for itself. The necessity of interchanging commodities calls for a circulating medium, and the money at hand will be made, one way or other, to answer the purpose. The chief difference arising from its scarcity or abundance, will consist in its higher or lower value.

With the view of ascertaining the limit to which a government should permit the currency of bank notes, Dr Smith enters at some length into the principles of the circulation of money. He divides it into two distinct branches;—the circulation in the wholesale trade between dealer and dealer, and the retail circulation between dealer and consumer. The latter being carried on in small sums, ought, he thinks, to be confined to metallic currency; while the former may, without hazard to the public security, be managed by bank notes. It would be highly impolitic for a country to divest itself wholly of the precious metals. For an advantage of no great consequence, it would thus become stripped of that circulating medium, which forms the currency of all the rest of the civilized world. Remove the check of cash payments, and there is no saying to what length the overissue of paper may be carried. Recent experience has shewn, that without any intention of imposing paper currency on the people, we have brought ourselves into a situation in which our notes bear a reduced value in comparison with coin. The exchange is consequently adverse to us in all directions; an evil which, whether we view it as obstructing our supplies of corn, or as crippling the foreign exertions of our government, is productive of incalculable mischief.

The limits suggested for our paper currency by Dr Smith were L. 10 as the lowest bank note in London, and L. 5 as the lowest in the country. These recommendations were adopted by government about forty years ago, and were productive of much advantage. The mass of small notes, circulating frequently for five shillings or less, was made to disappear, and the restriction was not attended with any material injury to trade. Banks of circulation continued to make loans as before to farmers, merchants, and manufacturers. The first deviation from Dr Smith's plan took place above twenty years ago, but was comparatively trifling, for it consisted in nothing more than a permission to the Bank of England to issue, like the country bankers, notes of L. 5. The grand alteration took place in 1797, on the suspension of cash payments; a step which was necessarily accompanied by an unlimited permission to issue notes of L. 1 and L. 2. From that time forward, paper has been regularly taking the place of gold and silver in our currency. Every year has added more or less to the substitution; but the foreign subsidies, and the corn importations of 1799, and the years immediately subsequent, carried off our specie by wholesale. Our bank paper then fell between 2 and 3 per cent. below our coin, a fall which it has never recovered. The final blow was given by our Orders in Council, and by the heavy drain of specie attendant on the prosecution of the war in Spain. Had government adhered to the precautions of Dr Smith, and kept our foreign expenditure within bounds, the crisis of 1797 would not have occurred. And had they, at the subsequent date of 1807, forborne to interfere with the course of trade, the evil would have been comparatively limited in its operation. A great part of the supplies necessary for the Spanish contest would have been furnished by the Americans, who would have taken (as they are always ready to take) payment in British manufactures. Moreover, the sums of money which we might still have found it necessary to expend in the peninsula, would have found their way back to us, directly or indirectly, through the endless channels of an unrestrained commerce. With this view it is important to remember, that the American trade with the continent regularly supplied us with four millions annually, in the shape of bill or specie remittances. This was a fund lasting stedfastly all the year through, and generally affording us between L. 150,000 and L. 200,000 a week. Unfortunately the silent and imperceptible manner in which these remittances took place, prevented our government from comprehending their magnitude, until the "deed was done," and we had, with our own hands, blocked up this ample source of supply. (χ)

CURRIE, James, M. D. was born in the south of Scotland, in that district of Dumfries-shire which derives its name from the river Annan. His father and grandfather were both clergymen of the church of Scotland. He was an only son, but had six sisters, two of whom survive and are respectably married, one of them to an eminent surgeon in London, and the other to a cousin of her own, a merchant in Liverpool. At the time of his birth in 1756, his father held the living of Kirkpatrick Fleming, but was soon afterwards removed to the neighbouring parish of Middlebie, where he ended his days before his son had attained his 18th year. His wife, Jean Boyd, a descendant of the ancient family of Kilmarnock, and a woman remarkable for the strength and cultivation of her understanding, died whilst the subject of this sketch was still at a very early age; but this loss was amply compensated to the family by the benevolence of Miss Christian Duncan, a half sister of Mrs Currie, who undertook the superintendence of the household, and dedicated her life to the service of her young relatives.

Under the eye of these estimable guardians, he received the first rudiments of education at the parochial school of Middlebie, and from their example insensibly imbibed those endearing qualities, which formed through life so remarkable a feature in his character. At the age of thirteen, he was sent to the grammar school of Dumfries, which was then ably taught by Dr Chapman, whose work on education has gained him deserved fame. Into the house of this eminent teacher he was received as a boarder, where he remained some time after he had finished his course in the school, for the purpose of learning mathematics and practical geometry.

Soon after leaving school he accompanied his father in a visit to Glasgow, at which college the worthy clergyman had received his education, and where he still retained some intimate friends. The bustle and enterprise of this flourishing place, opened a new scene to the ardent imagination of young Currie; and having caught the spirit of adventure common to his countrymen, his father was persuaded to send him out to Virginia in the service of a company of merchants. He sailed for America in 1771, where he remained five years, and underwent many hardships, having suffered from a long and dangerous illness, and been treated with harshness and neglect by some individuals in that country with whom he was connected. To add to his misfortunes, during this period he lost his father, by which blow he was at once deprived of a counsellor and friend, and reduced to depend for subsistence on his own industry; the produce of the family estate, which was indeed but trifling, being generously resigned by him for the support of his sisters. These complicated calamities, however, did not relax the native energies of his mind; and young as he was, he took an active part in the political discussions which then agitated the American colonies, and ended in their separation from the mother country. Though convinced of the impolicy of a war with our dependencies in that quarter, and from his local knowledge anticipating an unfavourable result, he had, in common with the great majority of his countrymen in Virginia, formed a decided opinion in favour of the rights which the British administration assumed of taxing the colonies; and he published in an American newspaper, some letters expressive of his sentiments, under the signature of "an Old Man," which gained him amongst his party a high but dangerous reputation. As soon as the troubles began to assume a more serious aspect, and to interfere with the regular course of mercantile pursuits, he went to reside with Dr Currie at Richmond, a near relation of his, and the principal physician in the colony, who persuaded him to change his line of life, and to adopt the profession of medicine, to which he had been originally destined. It was concluded between this gentleman and himself, that he should go back to Britain, and prosecute his studies at the university of Edinburgh, and after taking his degree, should return to practice medicine in the capital of Virginia. Before all this could be accomplished, it was confidently expected that peace would be restored. In prosecution of this plan, he accordingly set out for Britain by the way of the West Indies, as direct communication with the

Currie. mother country was by this time interrupted. He took his route from North Carolina by St Eustatius and Antigua, and after making some narrow escapes, having at one time fallen overboard, and being at another driven by stress of weather into the Azores, where he was exposed to the imminent risk of shipwreck, he arrived at London in the year 1776.

From London he went to Edinburgh, where he constantly resided for three years, prosecuting his medical studies with zeal and success, and gaining for himself a high reputation among his fellow students. In the Royal Medical Society, of which he was a distinguished member, some papers of merit written by him are still preserved, one of which we shall afterwards have occasion to mention, as it is of some importance in the history of one of the most happy discoveries which have ever been made in the healing art.

During the prosecution of his studies at the university, Currie resided in the house of his aunt Miss Duncan, who, on the death of his father, had removed to Edinburgh with his sisters, and to whom he was now partly indebted for the means of support. The funds of this benevolent woman, however, were but scanty, and he was well aware that, with his utmost economy, his necessary expences must strain her resources. He knew, indeed, that she would chearfully have divided with him her last shilling; but, under no circumstances, would his spirit have suffered him to remain easy in a state of dependence; and, situated as he was, he felt inexpressible distress, from the consciousness of adding to the burdens of his best friend. He resolved, therefore, at all hazards, to find out some opening, where he might have an opportunity of subsisting by his own exertions. With this intention he turned his views to a medical appointment in the army, and procured an introduction to General Sir William Erskine, who gave him an ensigncy in his regiment, with the office of surgeon's mate. Some of his friends, however, hearing of the step he had taken, thought the situation inadequate to his abilities, and determined to use their influence, for procuring him a more honourable and lucrative employment. A medical establishment being at that time about to be formed for the forces in Jamaica, it was resolved that an attempt should be made to place him on the staff of the army, by getting him appointed physician, or assistant physician, to the hospital in that island. No time, however, was to be lost, and a difficulty of considerable magnitude occurred. Though he had attended the university during the regular term, he had not yet graduated, and there are only two days in the year in which medical degrees are conferred in Edinburgh, the nearest of which (the 24th June) was two months distant. This difficulty was overcome, by his procuring a degree from the college of Glasgow, and he immediately began to solicit for his appointment. Except among his fellow students in the university, he had few friends, for he had lived a retired life of hard study, and of necessary economy. Among these, however, there were many to whom his virtues and talents had warmly endeared him, and who were eager to use their interest in his favour; and indeed some of the professors were not insensible to his merits, and offered their services in the most flattering manner. He went up to London, therefore, loaded with letters of introduction, which represented his character in terms of merited approbation. He was, however, unsuccessful. On his arrival, he found the appointment filled up by a young Irish physician, a man of great merit, the interest of Sir John Pringle having yielded to that of Mr Surgeon General Adair. Before leaving Scotland, he had, at all events, determined not to return; and contemplating the probability of a disappointment, he had formed the resolution, even in this case, to proceed to Jamaica, and attempt practice there, in the certain hope of having an easy opportunity of passing to his friend and kinsman at Richmond, so soon as peace should be re-established. It happened that the fleet in which he was to sail was delayed from time to time, in consequence of which he passed the greater part of the summer of 1780 in London. He here renewed his intimacy with a few of his college acquaintances, who had become eminent for their literary and professional talents, and was introduced into some of those circles, which render London to a man of taste and genius so desirable a residence. In this society, his abilities were quickly appreciated, and his friends began to persuade him, that he might obtain success in his profession, without the necessity of leaving the kingdom. He listened to such agreeable suggestions at first without hope; but on hearing them repeated and warmly urged, he began to see in them something plausible as well as flattering, and willingly suffered his mind to indulge in prospects so congenial to his wishes. An illness with which, about this time, he was seized, added strength to the arguments of his friends, and when at length the fleet sailed, he allowed it to depart without him, determining to wait for the next convoy, and, in the mean time, to put these arguments to the test of experience, by endeavouring to find a settlement in England. In the course of his enquiries, he paid a visit to some of his acquaintances in different parts of the country, and after some unsuccessful attempts in other places, hearing of Dr Dobson's removal to Bath, he repaired to Liverpool, where that gentleman had left a flourishing practice, and he settled in this great commercial town on the 7th of October 1780. At the time of his arrival, he was not acquainted with a single individual, but he was warmly and affectionately supported by some of his early friends, and he carried with him about forty letters of introduction, which procured him many invitations, and, by making him generally known, prepared the way for more useful connections. By great and persevering exertions, he secured to himself part of the vacant practice; and his prospects were brightened in 1783, by his marriage with Miss Lucy Wallace, a lineal descendant of the Scottish hero of that surname, and daughter of an Irish gentleman, who was settled in Liverpool as a merchant, and whose probity, honour, and worth, had gained him universal respect. Currie.

Previous to this fortunate event, he had formed an intimate acquaintance with the then most remarkable in Liverpool for their taste and science; and in 1782, was the chief instrument in forming a literary club, of which Mr Roscoe, who has since by his writings acquired such deserved celebrity, and that most admirable man William Rathbone, were constituting members. Speaking of this circumstance in a MS. account of his life written by himself, and contained in a confidential letter to a friend, from which the principal facts mentioned in the former part of this memoir are taken, he expresses much amiable satisfaction. "I am proud of this," says he; "it was the means of binding us all in friendship and confidence, and gave a considerable impulse to my literary pursuits." This society acquires additional importance when it is remembered, that it was the first institution of the kind in Liverpool, and may justly be considered as the parent of those splendid literary establishments which now embellish that flourishing town, and in the formation of which Dr Currie took so active a part.*

About the time of Dr Currie's settlement in Liverpool, his ingenious friend, countryman, and early companion Dr Bell, commenced practice with the most flattering prospects in the town of Manchester, and a constant intercourse of affection was kept up between them. In January 1784, Dr Bell was seized with an illness which terminated in his death; and the anxiety of friendship induced Dr Currie to pay him the most assiduous and unremitting attention. This, however, could not be reconciled with the duties of a rising practice without much personal inconvenience, and he was frequently forced to travel to and from Manchester under night, at a time when he was by other exertions much harassed and fatigued. The weather being during that season extremely severe, his efforts proved too violent for his constitution; and immediately after his return from Dr Bell's funeral, he was attacked with an inflammatory fever, which threatened his life, and had nearly deprived the world of those discoveries and writings by which he has since immortalized his name. The disorder afterwards settling on his lungs, gave rise to a severe cough, which seemed to indicate the approach of consumption. Dr Darwin inserted in the 2d volume of his Zoonomia, an account of this illness, and of the plan of treatment which Dr Currie successfully pursued. Soon after his recovery, which did not take place till autumn, he wrote a memoir of the life of his amiable and accomplished friend and benefactor, in which he paid an elegant tribute to the memory of departed worth. This work, which was his first acknowledged appearance from the press, was undertaken at the request of the Manchester Philosophical and Literary Society, and being published in the first volume of their Transactions, gained him considerable credit as an author.

An illness at that critical period of a young physician's life, when he first begins to be known, is frequently very detrimental to his views; but notwithstanding this unfavourable circumstance, Dr Currie's practice rapidly advanced; and the respectability and public esteem into which he quickly rose, fully realized the hopes, and justified the discernment of his friends. The endowments of his mind, indeed, and the qualities of his heart, united to the accomplishments which books and an extensive knowledge of mankind had enabled him to acquire, were such as could not fail to inspire confidence in his professional skill, and a warm and affectionate attachment to his person. His figure, which was tall and commanding, gave a dignified effect to his first appearance among strangers, which the good sense and intelligence of his countenance contributed to heighten, and which a more intimate acquaintance with his character and manners served strongly to confirm. In that easy kind of philosophical conversation, which is so much the delight of men of letters, he was peculiarly formed to shine; and no person ever left his company without feeling his mind enlightened and his taste gratified. But there was something more than the elegance and variety of his language, and the discriminating sagacity of his remarks, which gave a charm to Dr Currie's society, and raised him to a distinguished station among his contemporaries. In his professional capacity, he displayed a degree of skill and knowledge which could only be acquired by assiduous habits of study, and a talent for minute and accurate observation, joined to that manly self-confidence and promptness of decision, which distinguished the man of action from the man of mere speculation. Thus gifted, it is not surprising that he commanded an extensive practice in spite of the disadvantages of his situation, and found his company courted by men of all ranks who had any claim to literary acquirements. He was elected a member of the London Medical Society in 1790, and communicated to it an essay on "*Tetanus and Convulsive Disorders*," published in the third volume of its Memoirs. In 1792 he became a Fellow of the Royal Society: this, however, having been conferred upon him as an acknowledgment for having presented to that learned body a very curious and instructive paper, containing "An Account of the remarkable effects of a Shipwreck on the Mariners, with Experiments and Observations on the influence of Immersion in fresh and salt water, hot and cold, on the powers of the living body." This communication was published in the *Philosophical Transactions* of the year in which it was received, and may be considered as the first fruit of an ingenious and useful investigation, to which the Doctor had turned all the powers of his vigorous and persevering mind, and which ended in one of the most important discoveries that the history of medicine has to record.

To every thing that concerns the welfare of his species, Dr Currie's mind was peculiarly alive, and the interest he took in the political events of his day, amounted frequently to an agitating solicitude. We have already recorded a proof of his patriotic ardour, which displayed itself in the efforts of his juvenile pen at the commencement of the American revolution. Another instance of the same spirit occurred during his residence in London, in the summer of 1780, when the metropolis was the scene of those disgraceful riots which have consigned the name of Wilkes to infamous renown. Indignant at the conduct of the magistrates, and of the opposition in Parliament, he employed his talents in defence of administration, by writing a series of letters in the Public Advertiser, under the signature of *Caius*. These letters, which are three in number, and were afterwards republished by some unknown hand, in a collection of political papers, evince a masculine mind, and a heart deeply interested in the cause of his country and of human nature. In these publications, it will be remarked, he adopted the views of the Tory party, to which, in the early period of his life, he had an attachment. His political principles, however, gradually and insensibly took another bias; and the same patriotic feelings which led him in times of turbulence and anarchy to lend the weight of his talents in support of the crown, made his mind, under other circumstances, tremble for the rights of the community. This will account for an apparent change in his sentiments towards the latter period of his life, and we hesitate not to say, that the work which exhibits

Currie.

* It may not be improper to take notice in this place, of the benevolent exertions of Dr Currie in promoting another institution more immediately connected with his profession, though, in doing so, we transgress the order of time. In the year 1785, a proposal was made to connect with the public infirmary (of which Dr Currie was one of the physicians) an asylum for the reception of lunatics. This project the doctor zealously espoused, and warmly recommended in two letters, which he published in Gore's Liverpool Advertiser in 1789, and which are stamped with the characteristic elegance and ability of his pen. The result of his labours, combined with the exertions of other benevolent individuals, was the erection of a well-planned edifice, for the reception of those who suffer under the pressure of the worst of human ills, "the mind diseased."

the most striking evidence of the qualities we have attributed to him, is the "*Letter Commercial and Political, addressed to the Right Hon. William Pitt,*" which he published under the signature of *Jasper Wilson.* This pamphlet was never indeed publicly acknowledged by him, but to his intimate friends he did not scruple to avow it, * and it was universally understood to proceed from his pen. The history of the publication, so far as we have been able to trace it, was shortly this: The commencement of hostilities having been followed by many failures in the mercantile world, it became a matter of great public importance to discover how far these failures were imputable to the war. In order to ascertain this point, a gentleman who took an active part in the political struggles of the day, addressed a private letter to Dr Currie, with whom he was in habits of friendship, and whose talents he admired, containing some queries regarding the embarrassment of commercial affairs in Liverpool, as connected with political events. Dr Currie entered into the views of his friend with his characteristic zeal and perseverance, and he soon found the result of his enquiries to be so important, and to involve consequences of such magnitude and extent, that he could not, consistently with the duty he owed to the public, confine his discoveries wholly to the bosom of private friendship. He determined, therefore, to give them to the world as a free-will offering, rejecting all regard to personal fame, which, on such a subject, he knew might be detrimental to his professional interests, and concealing his real character under the shelter of a feigned name.

Jasper Wilson's letter made its appearance in 1793, a most critical and interesting period, when the country had been newly precipitated into the war with France, and when the ferment of the public mind was at its height. We do not stop to enquire into the wisdom or folly of our government on this momentous occasion, but shall merely observe, that, independently of the elegance and energy of its language, the extent of its information, and the profundity and enlargement of its views, the work owed its uncommon success principally to the seasonableness of the argument against the war which it maintained. All the original declared objects of the first coalition against the French republic had been gained, and the Brissotine faction were at that moment actually suing for peace. The pamphlet went quickly through three editions; and whilst it acquired for its author the warmest admiration amongst the partizans of one party, raised against him a host of enemies in the other. Several answers were attempted, and one of the respondents even used the unpardonable liberty of publishing a personal attack on Dr Currie, proclaiming him to the world by name as the reputed author. The violence and illiberality of his opponents did not provoke from him any answer, but it may be interesting to know in what temper he privately listened to their invectives. With this view, we quote the following passage from a letter now before us, written by him in March 1794 to his uncle and confidential friend, Mr Duncan of Lochrutton, a Scottish clergyman, whose unaspiring modesty, confined to the useful but obscure duties of a country parish, virtues, and accomplishments, would have adorned the most exalted station. "The reputation of this work," says he, "has procured, not to *Jasper Wilson*, but to your nephew, many false and foul imputations. The ministerialists and war-mongers are a most irritable set, and cannot bear to be reasoned with. Though they are strong in numbers, they have all the peevishness of conscious weakness; and when they cannot confute, they calumniate and misrepresent. Jasper Wilson has had the honour to be answered four or five times; and at last Dr Currie is publicly addressed by a clerk † in Lord Hawkesbury's office as 'the reputed author of Jasper Wilson's letter,' in a strain of unparalleled insolence, falsehood, and malignity. Mr Vansittart, whose pamphlet you have read, is the most gentlemanlike, and the most able of his answerers **** The statement of Vansittart respecting the treaty of Pilnitz, is a poor sophistry. There were two treaties—one secret, one divulged. The secret treaty he denies, or rather gives reasons for disbelieving; but you will see in the debates of the present session, that it is admitted on all sides. Respecting the finances of our allies, time has decided in favour of Jasper Wilson's speculations. * * * * * * It is seldom that calumnies injure an honest man, unless he makes a grand stir about them. I do not open my lips either about Mr Wilson or his antagonists, and I beg the same favour of my friends. * * * * *"

The interest which Dr Currie's benevolent mind led him to take in the general welfare, he did not suffer to interfere with his professional avocations; and it was on his medical skill and acquirements that he chiefly rested his title to celebrity. His affectionate attention to his patients, and the success which attended his prescriptions, would have insured to him a high reputation as a physician, even though his labours in the science to which his chief attention was due had extended no farther. But he had earned for himself no inconsiderable share of respect by the medical papers he had already published; and in October 1797, he gave to the world a professional work of the highest merit, under the title of "Medical Reports on the effects of Water, cold and warm, as a remedy in Fever and Febrile Diseases, whether applied to the Surface of the Body, or used internally."

It was chiefly by this publication that Dr Currie obtained that very distinguished rank in the medical world which has associated his name with those of the great benefactors of our species.

It is curious to observe, to what apparently trivial occurrences we are indebted for some of the most important discoveries in science and in art. The following is the history of that which is communicated in the work before us. In the month of September 1778, young Currie, in company with a fellow-student, left Edinburgh on a pedestrian excursion to Annandale. After a walk of somewhat more than sixteen miles, the travellers arrived on the banks of the Tweed, near Peebles, and, being heated by their exercise, eagerly plunged into the stream. The delightful coolness of the water renewed their vigour, and enabled them to proceed on their journey with alacrity. They had, however, to advance sixteen miles further, towards the source of the river, before a resting-place occurred; and towards the end of this long stage, they were exhausted with fatigue, and in a state of profuse perspiration. Here Currie again descended into the water,

* In one of the London prints there appeared a formal *disavowal* of the publication inserted in Dr Currie's name; but the writer of this article knows that the disavowal was not dictated by Dr Currie, and gave him serious uneasiness.

† Mr Chalmers, author of the "Comparative Estimate," &c.

trusting that he should experience the same refreshment as the morning's bath had afforded; but the result was exactly the reverse of what he had anticipated. A feverish chill, accompanied by extreme prostration of strength, painfully instructed him that an application which, in one state of the system, is salutary, may be noxious in another. This circumstance made a deep impression on his mind, and seems to have suggested that inquiry into "the effects of cold on the living body," which formed the subject of some ingenious speculations presented by him, soon after, to the Royal Medical Society of Edinburgh, and recorded in their manuscript Transactions. The ideas elicited in the course of the debate to which this paper gave rise, confirmed the interest which the author had taken in the subject, and induced him, from that time, to observe and note down such facts as seemed to illustrate it, particularly with a view to medical practice.

Much about this period, Dr Wright communicated to the Medical Society of London the result of his experience with regard to the efficacy of ablution with cold water in some cases of fever; but the paper containing this valuable information was not published in the London Medical Journal till 1786. Dr Currie had already learned how to appreciate the discrimination and judgment of the acute and worthy author; and finding in the work a remarkable coincidence with his own sentiments, he determined to adopt the system which it recommended, especially when he found that his colleague, Dr Brandreth, had already put it to the test of experience. In a practice so extensive as Dr Currie had even then acquired, early opportunities occurred of acting upon this resolution; and personal observation confirming the theoretical speculations of this accomplished physician, he was soon enabled to improve upon the suggestions of his predecessors, and to point out the causes of apparent inconsistencies in the effects which they recorded. He proved that cold water may at all times be safely and efficaciously employed in fevers, whether externally or internally, especially at their commencement, *when there is no sense of chilliness present, when the heat of the surface is steadily above what is natural, and when there is no general or profuse perspiration.* On the observance of these rules, of which Dr Currie is universally acknowledged to be the discoverer, the efficacy, and indeed the safety of this powerful remedy, entirely depend; for if they be unfortunately overlooked, it may be converted into an instrument of speedy and inevitable death. Dr Currie enriches and supports his reasonings on the action of cold upon the human frame, by scientific illustrations from the works of the ancients, and by the detail of numerous experiments made by himself, partly on the healthy, and partly on the diseased subject, which are evidently the suggestions of a great and comprehensive mind. These experiments were varied, by combining the water employed with various proportions of caloric, and sometimes impregnating it with salt. That he might proceed with greater accuracy, and state his cases with more precision, he called in the thermometer to his aid, and for the first time shewed the importance of this useful instrument in the hands of the physician, as a measure of the patient's temperature. Having once ascertained the general principles which were to regulate the practitioner in the employment of this remedy, he proceeded successfully to extend the use of it to various diseases, in some of which it had not previously been tried. He particularly established its utility in the eruptive fever of scarlatina, a pestilent disorder, whose ravages were becoming every day more extensive, and more alarming all over Europe, until checked, as we trust they now have been, by this happy discovery.

Following the excursive propensity of genius, our author includes in his reports various interesting facts and speculations not immediately but collaterally connected with the principal object of his book. He favours us with his opinions on the nature of fever in general; on animal heat; and on perspiration. He offers us some valuable observations on insanity, and on convulsive diseases. He discusses the effect, on the human system, of opium, of ardent spirits, of antimonials, of digitalis, and of nitric acid. He investigates several other curious questions in physiology, particularly that which relates to the inhaling power alleged by many ancient as well as modern observers, to be a property of the cuticle; and he everywhere captivates the reader by the rich variety of knowledge with which the exposition of his doctrines is enlivened. From the public situation which he held in a commercial town of very great resort, his name had previously been widely circulated, and his character stood high in the public opinion as a man of talents, candour, and benevolence. His book, too, was written in a style at once popular and luminous. In its subject every family was deeply interested; the evidences which he adduced in support of his positions were incontrovertible and conclusive; and the simple but powerful means by which he proposed to effect the most important ends were already in the hands of all. It can therefore be no matter of wonder that the "Medical Reports" were eagerly read by men of all professions; that they produced general conviction of their accuracy; that the principles which they explained were instantaneously diffused over the medical world; and that they quickly effected so great a change in the established modes of treating fevers and febrile diseases, that they might fairly be said to mark a new era in the history of medicine.

Dr Currie's genius was of that comprehensive kind which does not rest satisfied with attainments in one department of science, and he had always mingled with his professional pursuits a predilection for polite literature. The memoir of Dr Bell, which had been drawn from him by the claims of friendship, sufficiently proved the superiority of his biographical powers; and, in the year 1800, he gave a new evidence of the accuracy of his taste and judgment, as well as of the versatility of his talents, and the goodness of his heart, by publishing, in four volumes octavo, "*The Works of Robert Burns, with an Account of his Life, and Criticisms on his Writings; to which are prefixed some Observations on the Character and Condition of the Scotish Peasantry.*" To this undertaking Dr Currie was invited by motives of charity. Burns, after leading a life of greater fame than prosperity, and displaying a character more remarkable for genius than virtue, had died in circumstances of penury and wretchedness which would have left an indelible stain on the reputation of his countrymen, had not the blame been more justly due to his own imprudence and folly. Dr Currie had read the works of this bard of nature with an enthusiasm heightened by an amiable feeling of nationality, which he inherited as the birthright of his countrymen; and having, in the year 1792, paid a visit to his native county, he had become personally interested in the poet's fate, by being introduced to him, and experiencing the fascination of his social powers. On Burns's death, therefore, the destitute situation of the family excited

Fig. 2.

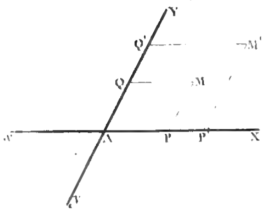


Fig. 3.

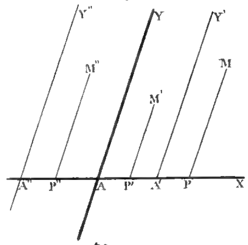
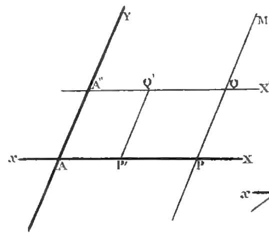


Fig. 4.



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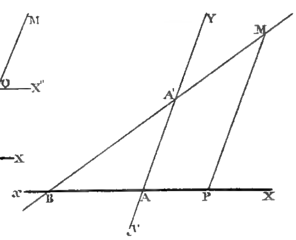

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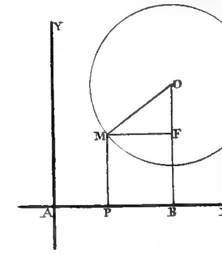

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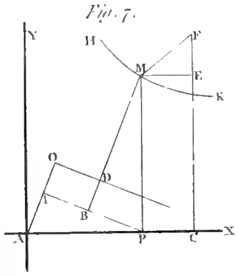

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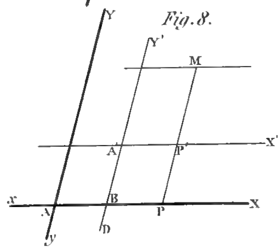

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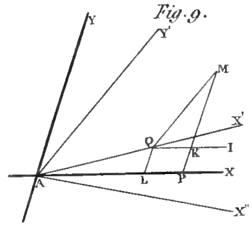


Fig. 10.

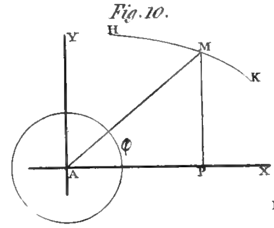


Fig. 11.

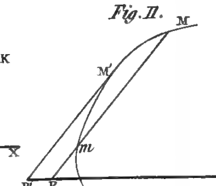


Fig. 12.

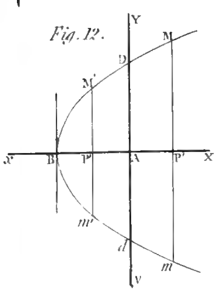


Fig. 13.

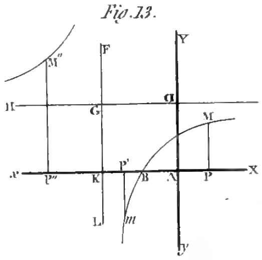


Fig. 14.

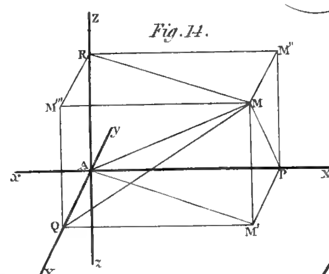


Fig. 15.

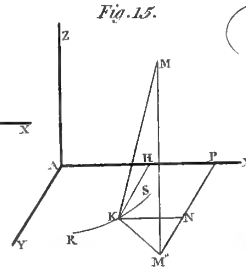


Fig. 16.

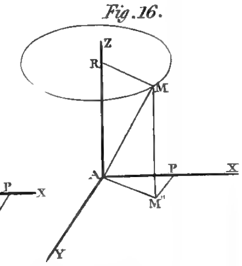
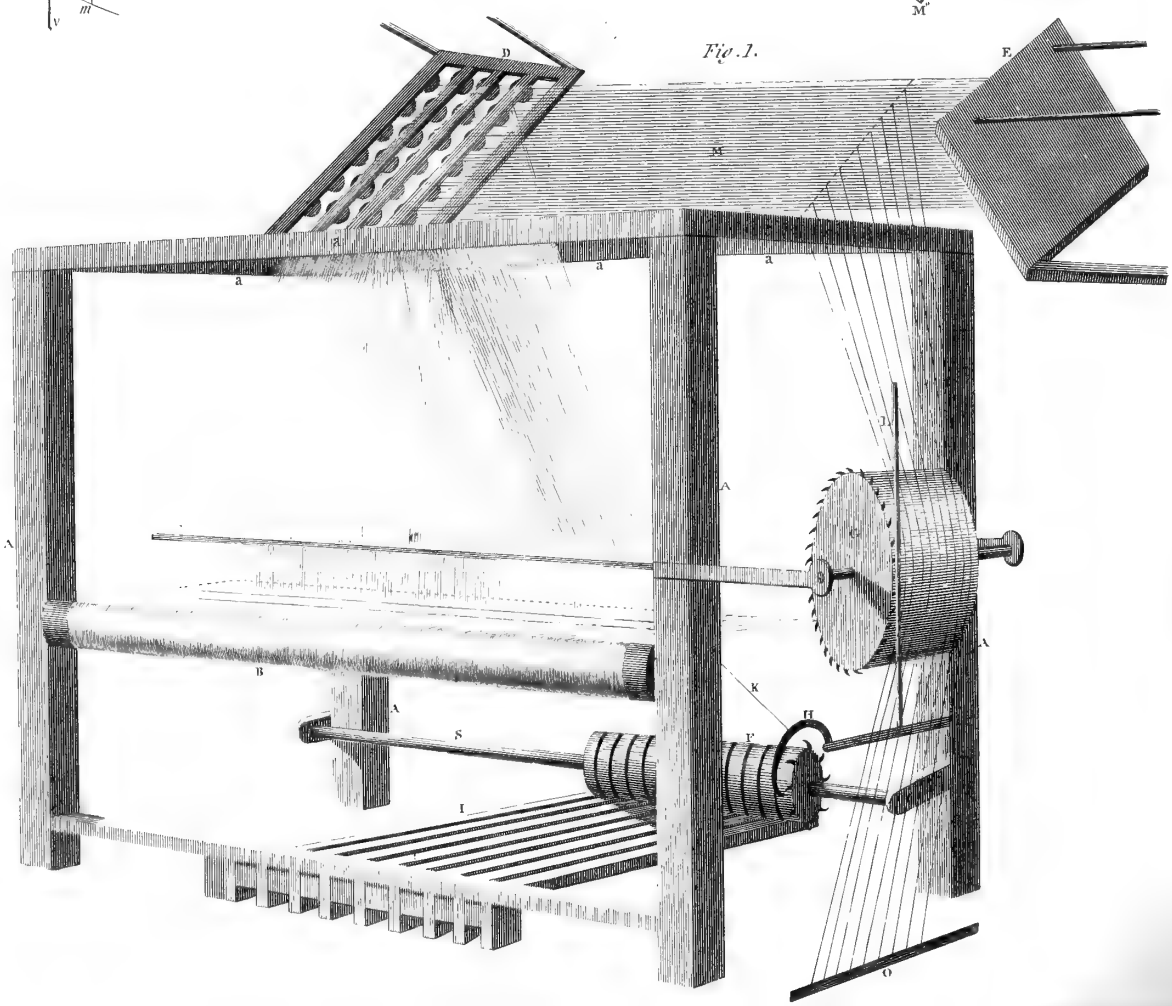


Fig. 1.



Engrav'd by J. Moffat Edin.

Currie.

in the Doctor's mind a strong feeling of compassion; and when his friend, Mr Syme of Ryedale, in conjunction with other persons of taste, urged him to become editor of the works of this extraordinary man, he did not feel himself at liberty to decline the call of benevolence. The task is universally allowed to have been performed with great ability, and its success fully equalled the most sanguine expectations. Repeated editions produced a balance of profit, which formed a little fortune for the widow and children of the deceased; and Dr Currie had the satisfaction of finding himself one of the most powerful friends of departed genius which the annals of British literature record.

The severe illness which threatened Dr Currie's life at the very commencement of his medical career, had given a shock to his constitution from which he never fully recovered, and in the early part of 1804 his health began visibly to decline. During the summer months of that year he paid a visit to Scotland; and, besides the salubrity of his native air, he found, in the delightful society of his early friends, a relaxation no less gratifying to his mind than invigorating to his bodily powers. The enjoyment of this last visit to the scene of his youthful pleasures, could not fail to be greatly enhanced by the opportunity it afforded him of witnessing the happy effect of his benevolent exertions on the family of Burns; and in speaking of this journey, he always dwelt with peculiar satisfaction on a subject which was so well calculated to interest the generous heart. He returned to Liverpool apparently in a state of rapid convalescence, but this flattering prospect was not of long duration. On the re-appearance of alarming symptoms, he found it necessary, in the month of November, finally to quit the climate and business of Liverpool, where the loss of his society and of his professional skill was deeply regretted. He spent the winter alternately at Clifton and Bath; and in the month of March, thought himself in such a state of recovery as justified his commencing the practice of his profession in the latter town. The acquisition of a man of such acknowledged eminence in the healing art, was hailed by the inhabitants of Bath, and by the invalids who frequented that celebrated watering-place, as a public benefit; and his career commenced in a manner which promised the highest success. He still continued sensible, however, of the precarious situation of his health; and in a letter which the author of this memoir received from him, dated "Bath, 14th July 1805," he alludes to the subject in the following terms: "I am still very delicate, I cannot well tell you how. I am weak, and easily made breathless; but I am at present rather better than usual. I am following my profession here, and am likely enough to *die in harness*." The scene was now soon to close. All his complaints returned with new violence, and, as a last resource, he went in August to Sidmouth, where, after much suffering, which he bore with manly fortitude and pious resignation, he expired on the 31st of that month, in the 50th year of his age. His disease was ascertained to be a great enlargement of the heart, accompanied with remarkable wasting of the left lung, but without ulceration, tubercle, or abscess. He left a widow and five children, who inherit his virtues. His eldest son is settled in Liverpool as a merchant, and his eldest daughter is married to an Irish gentleman.

The following affectionate, but just and discriminating tribute to the memory of this eminent man, appeared in a provincial paper, the production of an unknown hand: "Scotland has produced few characters whose names will descend to posterity with more splendid or more merited reputation. As a physician, he possessed the entire confidence of his patient; and his industry, anxiety, and skill, were attended with wonderful success. By his medical writings, he has thrown great light on the healing art; and particularly, by his reports on the effects of water in fever, has contributed, more than any man of the age, to arrest the progress and promote the cure of the most frequent and fatal diseases. As an author, independently of his professional writings, the memoirs of his early friend Dr Bell—the celebrated letter of Jasper Wilson to Mr Pitt—and the *Life of Burns*, place him in the first rank. No one that has felt interested in the premature fate of men of genius, can be indifferent to that of him, who, with a kindred mind and an impartial hand, has traced their sublime course, their wanderings, and their errors: Who, with a true admiration of their talents and their productions, has not omitted to point out their failings as a warning to others, and to inculcate the necessity of that prudence and exertion, without which 'wit becomes ridiculous, and genius contemptible.' To dignity of manners he united a social and most sympathetic spirit; and though somewhat formal on a first introduction, no man with more readiness engaged in the discussion of scientific or general subjects, or with more grace and pleasure relaxed, in easy conversation, into sportive and playful sallies of wit. In the interesting relations of life, he was uniformly firm, tender, and affectionate. He was a steady friend of liberty—a true and enlightened patriot, tha regarded, with an interest amounting to a painful anxiety, every thing in which his country was concerned, and those great events which, of late years, have agitated the political world. He aimed at and he possessed a high and honourable fame, which, as it was the reward of his useful labours, his elegant writings, and his great virtues, will live whilst excellence is honourable amongst men, and whilst the remembrance of its sons and benefactors is cherished by a grateful country." (H. D.)

CURTISIA, a genus of plants of the class Tetrandria, and order Monogynia. See BOTANY, p. 124.

CURVE LINES AND SURFACES.

Curve Lines.

1. THE theory of curve lines, is one of the most important additions which Descartes made to the science of mathematics, by the application of algebra to geometry. Before his time, indeed, algebra had been applied to the resolution of some particular geometrical problems; but it was he that first thought of expressing the nature of curve lines by algebraic equations, and thereby laid the foundation of some of the greatest improvements that have been made in both branches of the science.

2. A curve line may be defined to be, that of which no part is a straight line. The circumference of a circle, and the conic sections, are particular instances of such lines; but there may be an endless variety.

3. A curve surface is that of which no part is a plane. The surfaces of a cone, a sphere, and a cylinder, are of this nature.

4. If a curve lie entirely in one plane, it is called a plane curve; such is the circumference of a circle. But

Curve Lines.

if it does not lie all in one plane, it is called a curve of double curvature: the oblique rhumb lines on a common terrestrial globe are curves of double curvature.

5. In the theory of plane curves, the first thing to be considered is the manner of determining and describing the situation of a point on a plane. This may be done in various ways. For example, we may estimate its distance from two given points, and then its position will be determined by the intersection of two circles described on these points as centres, with its known distances from them as radii. Or we may consider how far the point is from a given point, and also from a straight line given by position, and either of these methods will apply with advantage to the describing of the conic sections; for it has been shewn, that the ellipse and hyperbola are lines of such a nature, that the sum of the distances of any point in the former curve, and their difference in the latter from two fixed points, is always a constant line; also, that the distance of every point in any of the three sections from a given point, has to its distance from a given line a given ratio. These methods, however, would not be found to be generally convenient, and therefore their application is limited to the particular curves referred to.

6. There are, however, two other methods of general and easy application. By the first, the situation of a point is determined by its distances from two straight lines, having given positions, and intersecting each other, (commonly at right angles,) just as the position of a point on the earth's surface is determined by its latitude and longitude; and by the second method, the position of a point is determined by its distance from a fixed point, and the angle which a line, drawn from it to that point, makes with a line given by position passing through the same point. We shall be most particular in explaining the first of these methods, or rather that method rendered somewhat more general, because the transition from it to the second is easy.

Plate CCXXVII. Fig. 2.

7. Let us suppose then, that xAX and yAY, Fig. 2, are two straight lines given by position, intersecting each other at any point A, and let M be any point in their plane. Draw MP, MQ parallel to AX, AY, meeting them in P and Q. The point M is manifestly determined, if we know the lines AP and AQ, and their directions in respect of the point A. The lines AX, AY produced indefinitely, are called the *axes*. The line AP, the segment of one of the axes intercepted between a line drawn from M parallel to the other axis, is called the *abscissa* of the point M; and the line PM or AQ is called its *ordinate*. The line AX is called the axis of the abscissæ; and AY that of the ordinates. It is a matter of indifference which of the two axes is taken for that of the abscissæ. Any abscissa, and its ordinate, are commonly called *co-ordinates*. The point A, from which the co-ordinates are reckoned, is called their *origin*. It is usual to denote any abscissa by x, and the corresponding ordinate by y, and to call AX the axis of x, and AY the axis of y.

8. If the two indeterminate lines AP, PM, or x and y, be supposed to have, for a certain position of the point M, the values

$$x=a,\ y=b,$$

as by these equations the position of the point is determined, we may call them *the equations* of the point.

The abscissa AP being supposed to remain the same, if the ordinate PM decrease, the point M will approach to the axis AX, so that PM, or b, becoming at last $=0$, M will fall on P; therefore the equations of any point P in the axis of the abscissa are of this form, $x=a$, $y=0$. If we now suppose the ordinate PM to remain the same and the abscissa AP to decrease, then M will approach to AY, so that at last QM vanishing, we have $x=0$, $y=b$, for the equation of any point in the axis of the ordinates.

Lastly, If we suppose both AP and PM to decrease, and vanish at the same time, then we have $x=0$, $y=0$, for the equation of the origin of the co-ordinates. We may therefore conclude, that by giving to x and y all possible values from 0 to infinity, we can indicate the position of every point whatever in the angle YAX.

9. That we may see how the position of a point in any of the other three angles made by the axes is to be indicated, let us suppose, that instead of AY, another line A′Y′, Fig. 3, parallel to the former, is taken for the axis of the ordinates. Let A=AA′, and let x' be the new abscissa, taken on the same axis AX, but reckoned from the new origin A′. If we now consider any point M, situated in the angle YAX, we have AP=AA′+A′P, or $x=A+x'$. But if we consider a point M′ situated in the angle Y′A′A, and still represent its abscissa A′P′ by x', which denotes a variable quantity of any magnitude whatever, we have AP′=AA′—A′P′, or $x=A-x'$; from which it appears, that if we wish to render the same analytical formula $x=A+x'$, applicable at once to points situated in the angle XA′Y′, and to points in the angle AA′Y′, we must for these last regard the values of x' as negative, so that the change of sign answers to their change of position with respect to the axis A′Y′. Plate CCXXVII. Fig. 3.

10. To confirm this result, and shew more clearly how the preceding formula may connect the different points of a plane, let us consider a point situated in the axis A′Y′ itself; then x' vanishes, and the formula $x=A+x'$ gives $x=A$; and this is the value of the abscissa AA′ with respect to the axes AX, AY. But if we wish that the same equation apply to points in the axis AY, let us consider any one point in that line; it is evident that its abscissa x is equal to 0, and therefore the preceding formula gives $A+x'=0$, or $x'=-A$, which is the value of the abscissa AA′ supposing it referred to the axis A′Y′. The analytic expression of this formula becomes therefore positive for the axis AY, and negative for the axis A′Y′, when the points of the plane are supposed connected by the equation $x=A+x'$. This result applies equally to negative values of x, and proves that they belong to points situated on the side of the axis AY, opposite to that on which the positive values are taken: For M″ being supposed any such point, we may always draw a new axis A″Y″, which has the same relative position in respect of AY as this last had in respect of the axis A′Y′.

11. By removing the axis AX parallel to itself, and fixing the new origin at A″, (Fig. 4,) making AA″=B, and putting y' for the new ordinates, reckoned from the axis A″X″, we shall have $y=B+y'$ for the points situated in the angle YA″X″, and $y=B-y'$ for those in the angle AA″X″; so that to comprehend both in the same analytic formula, the negative values of y' must be considered as corresponding to points situated on the side of the axis A″X″, opposite to that on which the positive values lie; and as this applies equally to the axes AX, AY, we may conclude, that the change of the sign of the variable line y, answers to a change of position of the points from one side of the axis of the abcissæ to the other. Fig. 4.

12. Upon the whole, it appears that the negative values of the co-ordinates must be taken in a direction the opposite to that of their positive values, otherwise the same formula cannot be applied to all the points of a plane, but will only comprehend the points situated in

Curve Lines.

the one angle of the axes. On the other hand, this conventional hypothesis being assumed, all the points in a plane, whatever be their position, may be comprehended in the same formula. Accordingly (Fig. 2.)

in the angle YAX, x is positive and y positive;
in the angle YAx, x is negative y positive;
in the angle XAy, x is positive y negative;
in the angle x A y, x is negative y negative;

consequently the equations $x=a$, $y=b$, which determine the position of a point in the angle YAX, become

$$x=-a \quad y=+b$$
$$x=+a \quad y=-b$$
$$x=-a \quad y=-b$$

according as the point shall pass into one of the angles YAx, XAy, xAy. By supposing a and b to be any quantities, positive or negative, the two first may represent all the others.

13. Every line that can be traced by a point moving according to some determinate law on a plane, may always be referred to two axes. The nature of such a line being expressed by some common property which belongs to all its points, that property will, in every case, furnish an equation expressing a common relation between the co-ordinates at any point whatever in the line, and as this equation will be characteristic of the line, it may be called *the equation* of the line.

Plate CCXXVII. Fig. 5.
14. As a particular example, let us consider the straight line BA′M, (Fig. 5.) which meets the axes AY, Ax in A′ and B. Then MP being drawn from any point in the line parallel to AY, we have, agreeably to the notation, AP$=x$, PM$=y$. Let us denote generally the segments which the line MA′B cuts off from the axes Ax, AY by a and b, giving to a and b the signs which belong to them from their position in respect of the origin A. In the Figure under consideration, we must, agreeably to what has been said, make AB$=-a$ and AA′$=+b$.

By the nature of a straight line, PM has to PB a given ratio. This property gives immediately $y=\text{H}x+\text{K}$ for the general equation of the line, H and K being put for invariable quantities. To determine H and K, it is to be observed, that when $x=0$, then $y=b$, and that when $y=0$, then $x=-a$, therefore in these two particular cases the general equation becomes $b=0+\text{K}$, $0=-a\text{H}+\text{K}$, hence we find $\text{K}=b$ and $\text{H}=\frac{\text{K}}{a}=\frac{b}{a}$, and thus the equation of the line is $y=\frac{b}{a}x+b$.

If α be put for the angle B which the straight line makes with AX the axis of the abscissæ, and β for the angle A contained by the axes AX, AY, then in the triangle AA′B, we have A′$=\beta-\alpha$, and since, by Trigonometry, $\frac{b}{a}=\frac{\text{Sin.}\ \alpha}{\text{Sin.}\ (\beta-\alpha)}$, the general equation of a straight line may also be expressed thus,

$$y=\frac{x\ \text{Sin.}\ \alpha}{\text{Sin.}\ (\beta-\alpha)}+b.$$

If we suppose the axes at right angles to one another, then Sin. $(\beta-\alpha)=$ Cos. α, and in this case $y=x$ Tan. $\alpha+b$. Each of these equations gives a positive value of y for every positive value whatever of x, and also for all negative values between $x=0$, and $x=-a$; but for every negative value of x beyond $-a$, we find that y is also negative; by which it appears, that the nature of a straight line, as well as the circumstance of its passing through the three *regions* YAX, YAx, xAy, are correctly indicated by its general equation.

Fig. 6.
15. To find a general equation for a circle in respect of two rectangular axes, let AB and BO, the co-ordinates of its centre, Fig. 6. (which we shall suppose situated in the angle YAX,) be denoted by a and b, and put c for its radius. From M any point in the circumference draw MF perpendicular to BO; then supposing x and y to be co-ordinates of M, we have PB$=$MF$=a-x$, and FO$=b-y$, and since MO$^2=$MF$^2+$FO^2, we have for the equation of the circle,

$$(a-x)^2+(b-y)^2=c^2,$$
$$\text{or, } x^2+y^2-2ax-2by=c^2-a^2-b^2.$$

If the origin of the co-ordinates be at the centre, then $a=0$, $b=0$, and the equation is simply $x^2+y^2=c^2$.

Plate CCXXVII. Fig. 7.
16. To find the equation of any conic section HMK referred to the rectangular axes AX, AY; let F be a focus, (Fig. 7.) OD the directrix, and AO its distance from A. Put AO$=d$, and let AC and CF, the co-ordinates of the focus, be denoted by a and b; and let α denote the angle which the axis of the conic section makes with AX the axis of the abscissæ. The lines AP$=x$ and PM$=y$ being the co-ordinates of any point M of the curve, draw PBI parallel, and MDB perpendicular to the directrix; also ME perpendicular to FC. The angles IAP, BPM, are manifestly each $=\alpha$; therefore

$$\text{AI}=\text{AP}\times\text{Cos.}\ \alpha=x\ \text{Cos.}\ \alpha,$$
$$\text{MB}=\text{MP}\times\text{Sin.}\ \alpha=y\ \text{Sin.}\ \alpha,$$

and hence MD$=y$ Sin. $\alpha+x$ Cos. $\alpha-d$. Moreover, in the right angled triangle MEF, we have

$$\text{MF}^2=\text{ME}^2+\text{EF}^2=(a-x)^2+(b-y)^2.$$

Let the determining ratio of the conic section be that of 1 to n; then because $1 : n^2 :: \text{FM}^2 : \text{MD}^2$ (See Conic Sections,) we have MD$^2=n^2\times$FM^2; in this expression substitute the values of FM^2 and MD^2, and we get

$$(y\ \text{Sin.}\ \alpha+x\ \text{Cos.}\ \alpha-d)^2=n^2\left\{(a-x)^2+(b-y)^2\right\}$$

for the equation of the conic section, and which, by putting

$\text{A}=n^2-\text{Sin.}^2\ \alpha$; $\quad \text{D}=2d\ \text{Sin.}\ \alpha-2n^2b$;
$\text{B}=-2\ \text{Sin.}\ \alpha\ \text{Cos.}\ \alpha$; $\quad \text{E}=2d\ \text{Cos.}\ \alpha-2n^2a$;
$\text{C}=n^2-\text{Cos.}^2\ \alpha$; $\quad \text{F}=a^2+b^2-d^2$;

may also be expressed thus,

$$\text{A}y^2+\text{B}xy+\text{C}x^2+\text{D}y+\text{E}x+\text{F}=0.$$

17. From the values of A, B, C, we find that

$$4\text{AC}-\text{B}^2=4n^2(n^2-1).$$

This property of the coefficients deserves attention, because it affords a criterion by which the kind of section to which the equation belongs may be immediately determined. Thus, if $4\text{AC}-\text{B}^2$ be a positive quantity, n must be greater than 1, and the section must be an ellipse. (See Conic Sections.) If, again, $4\text{AC}-\text{B}^2=0$, then $n=1$, and the section is a parabola; and lastly, if $4\text{AC}-\text{B}^2$ be negative, n must be less than 1, and the section is a hyperbola.

Fig. 8.
18. In the analysis of curve lines, it is often necessary to change the direction of the axes, as well as the origin of the co-ordinates, that is, to refer the curve to two new axes. The object of this change, in general, is to render the equation of a curve more simple in its form. Let us first suppose that the origin is to be changed, so that AX, AY (Fig. 8.) being the original position of the axes, they may have a new position A′X′, A′Y′, parallel to their former position. Let AB, BA′, the co-ordinates of A′, the new origin in respect of the original axes, be a and b; and supposing AP, PM, the co-ordinates of a point M, referred to the original axes to be x and y; let their new values A′P′, P′M be x' and y'. Then, because from the position of the lines, AP$=$AB$+$BP, PM$=$BA′$+$P′M, we have $x=x'+a$, $y=y'+b$. These values of x and y being substituted in the equation of any curve, it will be transformed into another, expressing the relation of x' to y', the new co-ordinates.

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In the Figure, we have supposed the new origin A′ to be in the angle XAY, in which a and b are both to be accounted positive; if it had been in one of the other three angles, we must, in like manner, have given to a, b, the signs which belonged to that angle. Thus, in the angle XAy, a would have been positive and b negative; so that we should have had $x=x'+a$, $y=y'-b$.

Plate CCXXVII. Fig. 9.

19. Having given the relation of $AP=x$ (Fig. 9.) and $PM=y$, the co-ordinates of a point M, referred to the axes AX, AY; let it be required to find the relation of $AQ=x'$, and $QM=y'$, the co-ordinates of the same point referred to other two axes AX′, AY′, having a given position in respect of the former, the origin of the co-ordinates A being supposed in both cases the same.

Put $\beta=XAY$, the angle which the axes make in their original position, also $\alpha=X'AX$, and $\alpha'=Y'AX$, the angles which the new axes make with AX, the original axis of the abscissæ. Draw QKI parallel to AX, meeting PM in K, and QL parallel to AY; then $MKI=\beta$, $AQL=\beta-\alpha$, and $QMK=\beta-\alpha'$. In the two triangles ALQ, QKM, we have, by trigonometry,

$$\text{Sin. }\beta : \text{Sin. }(\beta-\alpha) :: x' : AL,$$
$$\text{Sin. }\beta : \text{Sin. }\alpha :: x' : LQ=PK,$$
$$\text{Sin. }\beta : \text{Sin. }(\beta-\alpha') :: y' : QK=LP,$$
$$\text{Sin. }\beta : \text{Sin. }\alpha' :: y' : KM.$$

Hence,
$$AL\times\text{Sin. }\beta=x'\text{ Sin. }(\beta-\alpha),$$
$$LP\times\text{Sin. }\beta=y'\text{ Sin. }(\beta-\alpha')$$
$$PK\times\text{Sin. }\beta=x'\text{ Sin. }\alpha,$$
$$KM\times\text{Sin. }\beta=y'\text{ Sin. }\alpha';$$

and since by the position of the lines, $AP=AL+LP$, $PM=PK+KM$, we have

$$\left.\begin{aligned} x&=\frac{x'\text{ Sin. }(\beta-\alpha)+y'\text{ Sin. }(\beta-\alpha')}{\text{Sin. }\beta}\\ y&=\frac{x'\text{ Sin. }\alpha+y'\text{ Sin. }\alpha'}{\text{Sin. }\beta}\end{aligned}\right\}\ldots.(1.)$$

These values of x and y being substituted in the equation which expresses the relation of x to y, the result will be a new equation, expressing the relation of x' to y'.

In applying these formula to any particular case, regard must be had to the position of the new axes AX′, AY′, in respect of the former. Thus, if the new axes of the abscissæ were to have the position AX″ on the other side of AX′, then, instead of $\beta-\alpha$, we would have $\beta+\alpha$; and, in this case also, Sin. α must be reckoned as negative.

20. If the original axes contain a right angle, then Sin. $\beta=1$, Sin. $(\beta-\alpha)=$ Cos. α, Sin. $(\beta-\alpha')=$ Cos. α'; and, in this case,

$$\left.\begin{aligned} x&=x'\text{ Cos. }\alpha+y'\text{ Cos. }\alpha'\\ y&=x'\text{ Sin. }\alpha+y'\text{ Sin. }\alpha'\end{aligned}\right\}\ldots.(2.)$$

Again, supposing the original axes to contain a right angle, if the new axes also contain a right angle, in this case, $\alpha'-\alpha=90^0$, or $\alpha'=90^0+\alpha$, and Sin. $\alpha'=$ Cos. α, Cos. $\alpha'=-$Sin. α. See Arithmetic of Sines.

Hence these last formulas give us

$$\left.\begin{aligned} x&=x'\text{ Cos. }\alpha-y'\text{ Sin. }\alpha\\ y&=x'\text{ Sin. }\alpha+y'\text{ Cos. }\alpha\end{aligned}\right\}\ldots.(3.)$$

Examples of the application of these formulas to the transformation of equations, may be found in the concluding section of Conic Sections.

21. Let us now consider the other mode mentioned in Art. 6. by which the position of a point, or the nature of a line described on a plane, may be indicated.

Fig. 10. Let HK (Fig. 10.) be any line whatever. Assume AX a straight line, having a determinate position in the plane of HK, and take A, a given point in AX. If now, from M, any point in HK, a straight line MA be drawn to A, and we put r for AM, and φ for the angle MAX, it is evident that the position of M will be determined, if the line r and the angle φ are both known, and therefore that the nature of the line HK will be indicated by an equation expressing the relation between r and φ.

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By supposing the line AM to revolve about A as a pole, such a relation between r and φ may be assigned as shall determine its extremity M to describe any proposed curve. In this mode of generating curves, the angle φ, or the arc of a circle described on A as a centre with a radius $=1$, which serves to measure that angle, may be regarded as an *abscissa*, and the corresponding line r as the *ordinate*. The two are commonly called *polar co-ordinates* of the line HK; and the equation expressing the relation of φ to r, its *polar equation*.

22. It is easy to pass from the equation of a curve referred to two rectilineal axes, to its polar equation. For let AX, AY be rectangular axes passing through the pole A; and let $x=AP$, $y=PM$; then, by trigonometry, we have

$$x=r\text{ Cos. }\varphi,\ y=r\text{ Sin. }\varphi.$$

These values being substituted in the equation of the rectangular co-ordinates of a curve, it will immediately be transformed to its polar equation.

Thus the equation of a circle, viz.

$$x^2+y^2-2\,ax-2\,b\,y=c^2-a^2-b^2$$

gives us, for its polar equation,

$$r^2-2r\,(a\text{ Cos. }\varphi+b\text{ Sin. }\varphi)=c^2-a^2-b^2.$$

The most simple polar equations of the conic sections, are given towards the conclusion of the article Conic Sections.

The polar equation of a curve being given, we may, on the contrary, find the equation of its rectangular co-ordinates. To do this, it is only necessary to put $\frac{x}{r}$ for Cos. φ, and $\frac{y}{r}$ for Sin. φ, and afterwards to put $\sqrt{(x^2+y^2)}$ for r.

23. As there may be an endless variety of lines, in considering their relations one to another, it has been found necessary to class them. Accordingly, they have been divided, in the first place, into two kinds.

1. Such as may have their nature indicated by an equation of a finite number of terms, composed of integral powers of the indeterminate quantities x, y, (co-ordinates to two rectilineal axes,) and given quantities. Lines of this kind are called *algebraic*, also *geometrical*. Any straight line, a circle, and the conic sections, are particular examples of this kind of line.

2. Such lines as do not admit of their equations being expressed by a finite number of terms composed of integral powers of x, y, and known quantities. These are called *transcendental* curves, and sometimes, though improperly, *mechanical* curves. The cycloid is a curve of this kind; its equation may be deduced from these two,

$$x=a\,(1-\text{Cos. }\varphi),\ y=a\,(\varphi+\text{Sin. }\varphi),$$

by eliminating φ, and its functions Sin. φ, Cos. φ; but it will then necessarily consist of an infinite number of terms. Such curves also as have their equations of these forms, $y=a^{\frac{x}{n}}$, $y=x^{\frac{x}{n}}$, &c. are transcendental. They are also sometimes called *exponential* curves.

24. As algebraic curves still admit of an infinite variety, they have been divided into classes; and all lines whose equations are of the same degree in respect of the indeterminate co-ordinates x and y, constitute a class, or order, of the degree of the equation. The foundation of this mode of classification is the analytical fact, that *the degree of the equation of a curve cannot be changed by any change in the position of its axes.*

We have seen, (Art. 18.) that the origin of the co-ordinates is changed by making

$$x=a+x',\ y=b+y',$$

the new axes being supposed parallel to the former, and next that the direction of the new axes may be changed (Art. 19.) by taking

$$x'=m\,x''+n\,y'',\ y'=m'\,x''+n'\,y'',$$

a, b, m, m', n, n' being given quantities; therefore, to change both the origin and the position of the axes at once, we have only to assume

$$x=a+m\,x''+n\,y'',\ y=b+m'\,x''+n'\,y''.$$

But these values of x and y, when substituted in any equation in which x and y are the variable quantities, will always produce another equation of the very same degree, and having x'' and y'' for its variable quantities; and hence it happens, that by no transformation can the degree of the equation of a curve be changed.

25. A line of the first order, has its equation of the form

$$a+b\,x+c\,y=0;$$

this class consists of the straight line only. Lines of the second order, or curves of the first order, have their equations of the form

$$a+b\,x+c\,y+d\,x^2+e\,x\,y+f\,y^2=0.$$

This order comprehends four species, viz. the circle, the ellipse, the parabola, and hyperbola; or the two first may be considered as one species.

Lines of the third order, or curves of the second order, have for their equation

$$\left.\begin{array}{l} a+b\,x+c\,y+d\,x^2+e\,x\,y+f\,y^2 \\ +g\,x^3+k\,x^2\,y+i\,x\,y^2+k\,y^3 \end{array}\right\}=0.$$

This order may consist of more or fewer species, according to the principle of classification that is assumed. Newton, adopting one principle, subdivided them into 72 species; but to these, six have been added by Mr Stirling and Mr Stone. Euler, again, following another principle, has comprehended them in 16 general species; these, however, admit of being divided into many varieties: and Cramer, taking a different view of the subject, makes 14 classes.

Lines of the fourth order, or curves of the third order, have for their general equation

$$\left.\begin{array}{l} a+b\,x+c\,y+d\,x^2+e\,x\,y+f\,y^2 \\ \quad +g\,x^3+h\,x^2\,y+i\,x\,y^2+k\,y^3 \\ +l x^4+m x^3 y+n x^2 y^2+p x y^3+q y^4 \end{array}\right\}=0.$$

The lines expressed by this equation have been divided by Euler into 146 classes; and by Warring they have been comprehended in 12 cases of equations. The various species of curves, however, into which this order may be divided, amount to many thousands, and have never been distinguished individually. As to the fifth and higher orders, their number has precluded any attempt to arrange them in classes.

26. When the terms of an equation of any degree are put $=0$, if it represent a curve of that degree, it ought not to admit of being resolved into factors, which are rational in respect of x and y. If it does admit of such resolution, then each factor put $=0$ is the equation of a curve of any inferior degree, the co-ordinates of which satisfy the general equation.

The equation

$$a\,y-a\,x+x^2-2\,x\,y+y^2=0,$$

which is of the second degree, is the product of $x-y$ and $x-a-y$, so that it may be expressed thus,

$$(x-y)\,(x-a-y)=0.$$

This equation is satisfied either by making $y=x$, or $y=x-a$, and y can have no other values; now, these equations belong to two straight lines, therefore any co-ordinates of either of the two lines will satisfy the equation $a\,y-a\,x+x^2-2\,x\,y+y^2=0$, and consequently it does not represent a line of the second order, but two lines of the first order.

In like manner the equation

$$\left.\begin{array}{l} y^3-y^2\,x+y\,x^2-x^3 \\ +a\,y^2-2a\,x\,y+3\,a\,x^2-2\,a^2\,x \end{array}\right\}=0,$$

has the appearance of belonging to a line of the third order: but as it is the product of the two equations,

$$y-x+a=0,\ y^2-2\,a\,x+x^2=0,$$

the former of which belongs to a straight line, and the latter to a circle. The above equation of the third degree belongs at once to a straight line and a circle, and it cannot represent any other line.

27. From the connection which subsists between curve lines and equations, they may be reciprocally applied to the illustration of one another. As the nature of every curve generated according to some determinate law, may be expressed by an equation peculiar to that curve; so, on the other hand, corresponding to every equation involving two indeterminate quantities, there is a plane curve, the co-ordinates of which are the geometrical representatives of the variable quantities of the equation; so that all the circumstances regarding the latter are, as it were, graphically exhibited to the eye by the former.

28. The line, the co-ordinates of which represent the indeterminate quantities of any equation, is called the *locus* of the equation. The locus of an indeterminate equation of the first degree, is therefore a straight line; and that of an equation of the second degree is a conic section.

29. The position, the figure, and course of a curve, are known, when we can determine the points through which it passes. This may be done, by supposing one of the co-ordinates, as x, to have all possible successive known values, and by determining from these the corresponding values of y. Let the former be a, a', a'', &c. and the latter b, b', b'', &c. then the points whose equations are $x=a,\ y=b;\ x=a',\ y=b';\ x=a'',\ y=b''$, &c. will all be in the curve which is the locus of the equation, and may be readily found.

The determination of the points of a curve in this manner requires the resolution of its equation, which cannot in every case be effected; as, however, we can always find approximate values of the roots, the finding of the points of a curve is subject to no other difficulty than the labour of calculation.

30. As the co-ordinates of a curve admit of being the representatives of the roots of an equation, the properties of the latter will also belong to the former. It is upon this principle that the modern analysis has been applied with such success to the investigation of the various affections of geometrical figures; and these, in their turn, have been employed in illustrating some of the more intricate theories of pure analysis.

31. It is a fundamental proposition in analysis, that an equation of any degree may have as many real roots as there are units in the exponent of the highest power of the unknown quantity: hence it follows, that if the equation of any curve be resolved, so as to express the value of one of the co-ordinates in terms of the other; corresponding to any given value of the latter, the former may have as many values as there are units in its highest power contained in the equation; and this will be true, whatever angle the co-ordinates make with one another. This is an important proposition in the theory of curve lines; and from it we learn, that *a straight line cannot cut a line of any order in more points than there are units in the number expressing that order.* That this is true of the straight line and conic

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sections, we know from geometrical principles, (see GEOMETRY and CONIC SECTIONS); for a straight line cannot cut another straight line in more than one point, nor a conic section in more than two.

32. Although, generally speaking, a straight line may cut a line of any order in as many points as there are units in the number expressing its order, yet this will not always be the case; the roots of an equation may be impossible, and then they can have no geometrical expression.

33. As the roots of an equation become always impossible in pairs, so the intersections of a curve and its ordinate must vanish in pairs, if any vanish. Let PM (Fig. 11.) cut the curve in the points M and m, if it be supposed to move parallel to itself, so as at last to touch it in the point M′, then the two points of intersection M, m go into one point of contact M′. The line being supposed to continue its motion, it falls entirely without the curve, and there is no contact.

PLATE CCXXVII. Fig. 11.

34. As all equations of an odd degree, viz. the third, fifth, seventh, &c. have at least one real root, the equations of lines of the same orders will give at least one real value of y for every value of x: Now, x may increase indefinitely in both directions from the origin of the co-ordinates; therefore, such a curve will have at least two infinite arcs.

Again, as the roots of equations of even degrees, viz. the second, fourth, &c. may be possible only within certain limits, so, in curves of these orders, the values of x, which give real values of y, may be confined within certain limits, and hence the curve may be contained within certain bounds, so as to have the figure of an oval.

35. When two values of y are equal, the ordinate either touches the curve, or meets it in what is called a *Punctum Duplex;* two of its arcs intersecting each other in that point; or else some oval belonging to that kind of curve becomes infinitely little at the top of the ordinate, forming there a *Punctum Conjugatum.*

If in the equation of the curve y be made $=0$, the roots of the equation by which x is determined will give the distances of the points where the curve meets the axis of the abscissæ from the origin. If two of these roots are equal, the axis touches the curve, or passes through a *punctum duplex* in the curve: When $y=0$, if one of the values of x then vanish, the curve in that case passes through the origin; but if two vanish, the axis either touches the curve, or the origin of the co-ordinates is a *punctum duplex.*

36. In order to illustrate these observations, we shall now shew, by particular examples, how the figure of a curve may be determined from its equation.

Let the equation of the curve be $y^2=ax+ab$. In this case $y=\pm\sqrt{(ax+ab)}$. By giving particular values to $AP=x$ (Fig. 12.) and substituting for a and b their numeral values, we may find any number of values of $PM=y$, and thence any number of points M, M′, &c. in the curve: and as for every value of x, y has two values, one positive and the other negative; corresponding to each, there will be two points M, m at equal distances from the axis AX, and on opposite sides of it. The greater x is taken, the greater is $\sqrt{(ax+ab)}=y$; if x be supposed infinitely great, y is also infinitely great, so that the curve has two infinite arcs, which go off to an infinite distance from the axis AX. If we suppose $x=0$, then $y=\pm\sqrt{ab}$; from which it appears that y does not vanish, and therefore the curve does not pass through A the origin of the co-ordinates, but meets the axis YAy in two points D, d, so that $AD=Ad=\sqrt{ab}$.

Fig. 12.

Suppose now that P moves to the other side of A, so that $x=AP'$ is to be accounted negative; then $P'M'=y=\pm\sqrt{(ab-ax)}$; here y has two values as before, as long as x is less than b; when $x=b$, then $y=\pm\sqrt{(ab-ab)}=0$, so that the curve passes through B, a point in Ax, such, that $AB=b$. If P be supposed to move beyond B, so that $x>b$, then $ab-ax$ being negative, $y=\pm\sqrt{(ab-ax)}$ becomes imaginary, that is, beyond B, there are no ordinates that meet the curve; and consequently, on that side, the curve is limited at B. All this agrees with what is known by the theory of the conic sections; for the curve is evidently a parabola, whose vertex is B, and axis BAX, and the parameter of the axis $=a$. See CONIC SECTIONS.

36. Let the equation of the curve be $xy+ay+cy=bc+bx$: In this case, $y=\frac{bc+bx}{a+c+x}$; and as y has only one value, corresponding to every value of x, the ordinate $PM=y$ (Fig. 13.) can meet the curve only in one point: When $x=0$, then $y=\frac{bc}{a+c}$, so that the curve does not pass through A, the origin: If x be supposed to increase, then y increases, but never becomes equal to b, because $y=b\frac{c+x}{a+c+x}$, and $a+c+x$ is always greater than $c+x$. If x be supposed infinite, then the quantities a and c are to be accounted as nothing in respect of x; and in this case $y=b\frac{x}{x}=b$, from which it appears, that taking $AD=b$, and drawing DG parallel to AX, it will be an *Assymptote,* and touch the curve at an infinite distance.

PLATE CCXXVII. Fig. 13.

If x be now supposed negative, and AP′ be taken on the other side of A, then shall $y=b\frac{c-x}{a+c-x}$, and if x be taken on that side, $=c$, then $y=\frac{0}{a}=0$, so that if $AB=c$, the curve must pass through B.

If x become greater than c, then will $c-x$ become negative, and the ordinate will be negative, and be on the other side of the axis, till x becomes equal to $a+c$, and then $y=b\frac{-a}{0}$, that is y is infinitely great, so that if AK be taken $=a+c$, the ordinate KL will be an assymptote to the curve.

If x be taken greater than $a+c$, or AP″ greater than AK, then $c-x$ and $a+c-x$ become both negative, and consequently $y=b\frac{x-c}{x-a-c}$ becomes positive; and since $x-c$ is always greater than $x-a-c$, it follows that y will be always greater than b or KG, and consequently the rest of the curve lies in the angle FGH; and as x increases, since the ratio of $x-c$ to $x-a-c$ approaches continually to a ratio of equality, it follows that PM approaches to an equality with PN, and the curve approaches to its assymptote GH, on that side also. This curve is the common hyperbola.

Curve Surfaces.

37. The theory of curve surfaces, and of lines of double curvature, follows next in order that of plane curves. This is a subject, however, of great extent; and to enter upon it at any considerable length would require more room than the limits of our work will allow. We shall, therefore, give a very brief sketch of some of the principles of this branch of geometry.

38. The position of any point in space is determined, when we know the directions and the lengths of three straight lines, drawn from the point parallel to three planes, and terminated by them. For greater simpli-

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Plate CCXXVII. Fig. 14.

city, we may suppose the planes at right angles to one another; then, if they be represented by YAX, XAZ, YAZ, (Fig. 14.) and if it be known that a point M is placed at the distance MM′ from the first, MM″ from the second, and MM‴ from the third, it follows, from the property of parallel planes being every where equally distant from one another, that if three planes M‴MM″, M‴MM′, M″MM′, be drawn parallel to the former, at the given distances from them, the point M will be found at their mutual intersection.

39. The rectangular planes YAX, YAZ, XAZ, to which the points of space are referred, are called the *Co-ordinate planes.* They cut each other, two and two, in the directions of three straight lines, AX, AY, AZ, which pass through the same point A, and are perpendicular to one another.

40. From the nature of parallel planes, the distance MM′ may be measured on the line AZ, and is equal to AR; in like manner, the distance MM″ may be measured on the line AY, and is equal to AQ; and, lastly, the distance MM‴ may be measured on AX, and is equal to AP.

41. The straight lines AZ, AY, AX, upon which the distances of the point M from the planes are reckoned, are called the *axes* of the *co-ordinates*, and the point A is called the *origin.* The line AP=MM‴, the distance of M from the plane, which is perpendicular to AX, may be denoted by x; and similarly, the line AQ=MM″, the distance of M from the plane perpendicular to AY, may be expressed by y; and the line AR=MM′, the distance of M from the plane perpendicular to AZ, by z.

If, therefore, the three distances, AP, AQ, AR, are found to be a, b, c, we have to determine the position of the point M, these three equations,

$$x=a,\ y=b,\ z=c;$$

and as they suffice for that purpose, they may be called the *equations of the point* M.

The positions of the points M′, M″, M‴, which are called the *projections* of the point M on the three coordinate planes, are determined by these equations, for we have $y=b$, $x=a$, for the co-ordinates of the point M′, the projection of M upon the plane YAX; also, $x=a$, $z=c$, for the co-ordinates of M″, the projection of the point M on the plane XAZ; and $z=c$, $y=b$, for the co-ordinates of M‴, the projection of the point M on the plane ZAY. From the nature of these equations, it is evident that any two of them being known, the third is also known.

42. It follows from what has been said, that all the points of space being referred to three planes perpendicular to one another, the points of each plane may be naturally referred to two straight lines perpendicular to one another, which are the intersections of that plane with the two others. Thus, if each plane be denoted by the co-ordinates which belong to it, the plane YAX shall be that of x and y; the plane XAZ that of x and z; and the plane ZAY that of y and z.

43. Whatever has been said (Art. 9.—11.) respecting the signs of the co-ordinates of plane curves, applies equally here to the axes AX, AY, AZ; and it follows that the signs of the co-ordinates, x, y, z, shew the position of every point whatever in respect of the co-ordinate planes, it being understood that these are indefinitely extended, and that the straight lines AX, AY, AZ, are each produced indefinitely both ways from A, the common origin.

Agreeably to this conventional mode of representing the position of a point in space, according as it is in one or other of the eight angles which have their common vertex at A, the signs of its co-ordinates will be as follows:

$+x$, $+y$, $+z$, in the angle AXYZ,
$+x$, $+y$, $-z$, in the angle AXYz,
$+x$, $-y$, $+z$, in the angle AXZy,
$-x$, $+y$, $+z$, in the angle AYZx,
$+x$, $-y$, $-z$, in the angle AXyz,
$-x$, $+y$, $-z$, in the angle AYxz,
$-x$, $-y$, $+z$, in the angle AZxy,
$-x$, $-y$, $-z$, in the angle Axyz.

44. Let M be any point in a surface of a known nature, and which is referred to the three planes AM′, AM″, AM‴; We may suppose MM‴$=x$ and MM″$=y$, its distances from two of the planes, to have any magnitudes that admit of the point M being on the surface, and corresponding to these, MM′$=z$, its distance from the third plane, will have a magnitude, depending on the nature of the surface; therefore the value of z depends jointly on the values of x and y, so that these being known, z is also known.

The equation which expresses the relation of z to x and y is called the *equation* of the *surface*: so that like as the nature of a line on a plane may be expressed by an equation involving two indeterminate quantities, the nature of a surface may, in general, be expressed by an equation containing three indeterminate quantities.

45. The position of a point M being given in space by its co-ordinates x, y, z, its distance MA from A the origin is known. For we have $AM^2=AM'^2+M'M^2=AP^2+PM'^2+M'M^2=x^2+y^2+z^2$. Hence also the co-ordinates of any two points being given, their distance is known; for let x', y', z', be the co-ordinates of the second point, and let us suppose the co-ordinate planes to be transferred parallel to themselves, so that the origin may be at the first point; then the new co-ordinates will be $x'-x$, $y'-y$, $z'-z$, and the distance of the second point from the new origin, that is from the first point, will be

$$\sqrt{\left\{(x'-x)^2+(y'-y)^2+(z'-z)^2\right\}}$$

46. The equation of a plane may be readily found from the analytical expression for the distance between two points, by considering it as a surface, every point of which is equally distant from two given points. Let the co-ordinates of the two points be

$$a,\ b,\ c;\ a',\ b',\ c';$$

and let x, y, z, be the co-ordinates of any point in the plane. The general expression for the distance of any point in the plane, from the point whose co-ordinates are a, b, c, will be

$$\sqrt{\left\{(x-a)^2+(y-b)^2+(z-c)^2\right\}};$$

and its distance from the point whose co-ordinates are a', b', c', will in like manner be

$$\sqrt{\left\{(x-a')^2+(y-b')^2+(z-c')^2\right\}}.$$

By putting the squares of these distances equal to one another, we get

$$-2ax-2by-2cz+a^2+b^2+c^2$$
$$=-2a'x-2b'y-2c'z+a'^2+b'^2+c'^2.$$

Let $A=2(a'-a)$, $B=2(b'-b)$, $C=2(c'-c)$, $-D=a'^2-a^2+b'^2-b^2+c'^2-c^2$, and we get

$$Ax+By+Cz+D=0$$

for the equation of a plane, from which it appears that the equation of a plane is the most general that can be formed by three indeterminate quantities of the first degree.

If we suppose one of the points to be at the origin of the co-ordinates, so that $a'=0$, $b'=0$, $c'=0$, the equation becomes

$$2(ax+by+cz)=a^2+b^2+c^2.$$

The point whose co-ordinates are a, b, c, is now in a line drawn from the origin perpendicular to the plane, and as far distant from it on one side as the origin is on the other; but if we now put the letters a, b, c, for co-ordinates of the point in which the perpendicular meets the plane, as the new values will be the halves of their former values, we have

$$ax+by+cz=a^2+b^2+c^2$$

for the equation of a plane.

Plate CCXXVII. Fig. 14.

47. We may introduce into the equation the angles which the perpendicular from the origin upon the plane makes with the axes, instead of a, b, c. Let AM (Fig. 14.) be the perpendicular, and M the point in which it meets the plane; then $MM'''=AP=a$, $MM''=AQ=b$, $MM'=AR=c$. Put α for the angle MAX, β for MAY, and γ for MAZ; and put d for MA, the distance of the plane from A. The angles MPA, MQA, MRA, being right angles, we have $AP=MA\times \text{Cos. }\alpha$ $AQ=MA\times \text{Cos. }\beta$, $AR=MA\times \text{Cos. }\gamma$, and $AM^2=AP^2+PM^2=AP^2+PM'^2+M'M^2$, that is in symbols $a=d\text{ Cos. }\alpha$, $b=d\text{ Cos. }\beta$, $c=d\text{ Cos. }\gamma$, $d^2=a^2+b^2+c^2$. Therefore, substituting in the equation, and dividing by d, it becomes

$$x\text{ Cos. }\alpha+y\text{ Cos. }\beta+z\text{ Cos. }\gamma=d.$$

By putting $d\text{ Cos. }\alpha$, $d\text{ Cos. }\beta$, $d\text{ Cos. }\gamma$, instead of a, b, c, in the equation $a^2+b^2+c^2=d^2$, we shall find that α, β, γ, are so related to one another, that

$$\text{Cos.}^2\,\alpha+\text{Cos.}^2\,\beta+\text{Cos.}^2\,\gamma=1.$$

48. Having given the equation of a plane, its position may be determined from these formulas. Let the equation be $Ax+By+Cz+D=0$; by putting it in this form, $\frac{A}{D}x+\frac{B}{D}y+\frac{C}{D}z+1=0$, and substituting A for $\frac{A}{D}$, B for $\frac{B}{D}$, and C for $\frac{C}{D}$, it will have this form, $Ax+By+Cz+1=0$. Compare this with the expression $-x\frac{\text{Cos. }\alpha}{d}-y\frac{\text{Cos. }\beta}{d}-z\frac{\text{Cos. }\gamma}{d}+1=0$, and we get $\text{Cos. }\alpha=-dA$, $\text{Cos. }\beta=-dB$, $\text{Cos. }\gamma=-dC$; from these equations we get $d^2(A^2+B^2+C^2)=\text{Cos.}^2\,\alpha+\text{Cos.}^2\,\beta+\text{Cos.}^2\,\gamma=1$, and $d=\frac{1}{\sqrt{(A^2+B^2+C^2)}}$. As we now know d, the distance of the plane from the origin of the co-ordinates, and α, β, γ, the angles which a perpendicular from the origin upon the plane makes with the axes, its position is determined.

The position of a plane may also be determined by other *data*, particularly by its intersections with the co-ordinate planes, which are called its *traces*; but our limits do not admit of our enlarging on this subject.

49. As the intersection of two planes is a straight line, if those have given positions, the line will have a determinate position. The position of a straight line in space may therefore be expressed analytically by the equations of any two planes which pass through the line. Accordingly, the *equations* of a straight line referred to three co-ordinate planes are,

$$Ax+By+Cz+1=0 \quad \ldots\ldots \quad (1.)$$
$$A'x+B'y+C'z+1=0 \quad \ldots\ldots \quad (2.)$$

the variable co-ordinates x, y, z, being supposed the same in both. These serve to characterize the nature of the line; for by giving any particular value to one of the co-ordinates, we can, by means of them, determine the other two, and thence the point of the line corresponding to the co-ordinates.

The above equations, however, are not the only ones by which the position of the line is determined, for we may eliminate each of the three quantities x, y, z, in its turn. Let this be done, and, for the sake of brevity, let

$$AB'-A'B=C^1,\quad CA'-C'A=B^1,\quad BC'-B'C=A^1,$$
$$A-A'=A^2,\quad B-B'=B^2,\quad C-C'=C^2,$$

and we shall get

$$C^1y-B^1z+A^2=0 \quad \ldots\ldots \quad (3.)$$
$$A^1z-C^1x+B^2=0 \quad \ldots\ldots \quad (4.)$$
$$B^1x-A^1y+C^2=0 \quad \ldots\ldots \quad (5.)$$

Any two of these equations (3.), (4.), (5.), may serve instead of equations (1.), (2.), and they implicitly contain the third.

The equation (3.), which expresses the relation the co-ordinates y, z, ought to have to one another for all the points of the proposed straight line, belongs also to a straight line traced on the plane YAZ, by letting fall perpendiculars from every point in the line in question on that plane, or to the intersection of the plane YAZ, and a plane passing through the line perpendicular to YAZ. The same is true also of equation (4.), in respect of the plane XAZ, so that by chusing the system of these two equations, the straight line proposed is considered as the intersection of two planes respectively perpendicular to the planes YAZ, XAZ. These planes, which are called the *projecting planes* of the straight line, because they meet the co-ordinate planes to which they are perpendicular in the projections of that line, are characterized by equations (3.) and (4.), each considered by itself.

In general, every equation containing two variable quantities comprehended in the same co-ordinate plane, ought to be regarded as belonging to a line traced through the bottoms of an infinite number of perpendiculars erected on that plane. If all the perpendiculars stand upon a single straight line, they will lie in a plane perpendicular to the co-ordinate plane. It must also be remarked, that when only one of the co-ordinates is determined, a plane is thereby indicated parallel to that to which the ordinate is perpendicular.

50. The equations of curve surfaces come next to be considered after that of a plane. Let us take the sphere as an example; supposing the co-ordinates of any point on its surface to be x, y, z, those of its centre to be a, b, c, and its radius $=d$, the expression we found in article 45, for the distance between two points in space gives us immediately

$$(x-a)^2+(y-b)^2+(z-c)^2=d^2;$$

or, $x^2+y^2+z^2+2ax+2by+2cz=d^2-a^2-b^2-c^2$, for the equation of the surface of a sphere.

If the centre of the sphere be at the origin of the co-ordinates, then a, b, c, are each $=0$, and the equation of the surface is simply $x^2+y^2+z^2=d^2$.

If a sphere be cut by a plane, it is known that the section will be a circle; now, as the co-ordinates of every point in the circumference of this circle must satisfy at once the equations of the sphere and plane, the position of a circle in space will be expressed by these two equations, viz.

$$Ax+By+Cz+D=0;$$
$$(x-a)^2+(y-b)^2+(z-c)^2-d^2=0.$$

51. Let RKS (Fig. 15.) be a line of any kind traced on the plane XAY, the nature of which is known by an equation between its co-ordinates AH and HK; and let a straight line KM move in space, so as to be always parallel to a line given by position, and at the same time pass through the line RS; by this motion, the line KM will generate in space the surface of a solid which may be called a *cylinder*, because of its analogy to the cylinder of the elements of geometry. Plate CCXXVII. Fig. 15.

To find the equation of this kind of surface, let $AP=x$, $PM''=y$, and $MM''=z$, be the co-ordinates of any point on it: Join KM″, and draw KN parallel to AX. Because the lines KM, MM″ are parallel to lines given by position, the plane KMM″ is parallel to a plane given by position, therefore KM″, its intersection with the plane XAY, is parallel to a line given by position; thus the angles MKM″, M″KN will each have a given magnitude; and as KM″M, KNM″ are right angles, the triangles KMM″, KNM″ are given in species: Hence KN, NM″ will each have a given ratio to M″K, and consequently to MM″. We have therefore $KN=mz$, $NM''=nz$, (where m and n express given numbers,) and as $AH=AP-KN$, and $HK=PM''-M''N$, we have $AH=x-mz$, and $HK=y-nz$: Therefore these values of AH and HK being substituted in the equation expressing the nature of the curve RKS, the result will be the equation of the surface of the cylinder.

Example. Let the curve RKS, the base of the cylinder, be a circle, whose centre is at A, the origin of the co-ordinates, and its radius $=a$. In this case $AH^2+HK^2=a^2$; therefore the equation of the surface of the cylinder is $(x-mz)^2+(y-nz)^2=a^2$, or

$$x^2+y^2+2mxz+2nyz+(m^2+n^2)z^2=a^2.$$

If the line KM be perpendicular to the plane XAY, then m and n are each $=0$, and the equation of the cylinder is $x^2+y^2=a^2$. In general, the equation of the surface of a cylinder perpendicular to one of the co-ordinate planes, is the same as that of its base or section with the plane.

To find the equation of the surface of a right cone whose vertex is at A, the origin of the co-ordinates, and the axis AR coincides with AZ, the axis of the ordinate Z. Let $AP=x$, $PM''=y$, and $M''M=z$, be the co-ordinates of any point M on the surface. Draw MR perpendicular to the axis of the cone, and join M″A. Because the cone is given, the ratio of RA to RM, that is, of MM″ to M″A is given; therefore $M''A=nz$, (n being a given quantity,) and since $AM''^2=AP^2+PM''^2$, we have for the equation of the cone

$$x^2+y^2=n^2z^2.$$

It appears that the surfaces of a sphere, a cylinder, and cone, have equations of the second degree, involving three indeterminate quantities. They therefore, as well as innumerable other surfaces, may be all included in one equation of this form

$$\begin{aligned}&Az^2+By^2+Cx^2+Dyz+Exz+Fxy\\&+Gz+Hy+Kx+L=0.\end{aligned}$$

As lines are arranged in classes according to the order of their equations, a like mode of classification may be applied to surfaces. Accordingly, on this principle, a plane is called a *surface of the first order*, and all surfaces expressed by the above equation are said to be of the *second order*.

The equation of a curve surface admits of transformations perfectly analogous to those we have explained in treating of curve lines: and they are effected in the same manner, viz. by changing the origin and the direction of the co-ordinates. Thus the general equation to a surface of the second order may be changed to

$$x^2+My^2+Nz^2+P=0,$$

where x, y, z still denote co-ordinates to perpendicular planes.

As a plane curve is produced by the common section of a plane, and a curve surface of any kind, a curve of *double curvature* may be produced by the section of two curve surfaces. If a sphere and right cylinder, for example, pass through each other, so that the centre of the sphere is in the circumference of the cylinder, the common section of their surfaces will be a curve of double curvature.

Let the centre of the sphere be at the origin of the co-ordinates, and its radius $=a$, also let the axis of the cylinder be in the plane XAZ, and put b for the radius of its base; then the equation of the two surfaces will be

$$x^2+y^2+z^2=a^2;\ 2bx-x^2=y^2.$$

And these two equations express the nature of the curve under consideration.

By eliminating y^2 from the first equation, we have the nature of the curve also expressed by the equations

$$2bx+z^2=a^2,\ 2bx-x^2=y^2.$$

Of these two equations, the second is the equation of the *projection* of the curve on the plane XAY, and the first is the equation of its projection on the plane XAZ; so that instead of considering the curve as the common section of a sphere and cylinder, we may regard it as the common section of two right cylinders, one having a circle for its base, on the plane of the co-ordinates x, y, viz. that which we have supposed in the hypothesis of the problem; and another having its base on the plane of the co-ordinates x, z. The equation of the surface of this last being $2bx+z^2=a^2$, it is easy to see that its base is a parabola.

Whatever has been said in a former article respecting the straight line, which is the common section of two planes, will apply equally to curves of double curvature, considered as the sections of two curve surfaces. Thus, let $z=F(x,y)$, $z=f(x,y)$, be the equations of the surfaces, where $F(x,y)$, and $f(x,y)$ denote any *functions* or *expressions* of calculation made up of x, y, and known quantities; the co-ordinates of the curve, which is their common section, must satisfy both these equations at once. Also, by elimination, we may deduce from these, three other equations, $z=\Phi(x)$, $z=\varphi(y)$, $y=\psi(x)$. These give respectively the projections of the curve of double curvature upon the planes of x, z, of y, z, and of x, y; each equation may be considered as belonging to a cylindric surface, the base of which is upon the plane of the two ordinates which enter into the equation. It follows from thence, that there are always five curve surfaces, any two of which may form, by their intersections, one and the same curve of double curvature, so that such a line may be formed in ten different ways.

On the theory of curve lines, the following works may be consulted,

Des Cartes' *Geometria.*

Newton and Stirling's *Enumeratio linearum tertii ordinis.*

Maclaurin's *Geometria Organica.*

Maclaurin, *De Linearum Geometricarum Tractatus*, end of his *Algebra.*

De Gua's *Usages de l'Analyse de Descartes.*

Euler's *Introductio in Analysin Infinitorum.*

Clairaut's *Recherches sur les Courbes à double Courbure.*

L'Hospital *Analyse des infinement petits.*

Cramer *Introduction à l'analyse des lignes courbes.*

Lagrange's *Theorie des functions Analytiques.*

Waring's *Proprietates Algebraicarum Curvarum.*

Du Sejour et Goudin's *Traitès des courbes algebriques.*

Biot's *Essai de geometrie analytique.*

L'Huillier *Elemens d'Analyse Geometrique.*

Monge's *Application de l'Analyse a la Geometrie.*

The *Journal de l'Ecole Polytechnique*, and the *Correspondence sur cette Ecole*, contain many valuable memoirs on this subject.

The general Properties of Curve Lines, by Emerson.

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CUSCO, or Cuzco, the most ancient city of Peru, in South America, the capital of a corregiomento in that viceroyalty, and the head of a bishopric. This city is situated in south latitude 13° 42′ 25″, and in west longitude 71° 4′ 15″, being distant from Lima 184 leagues, and 290 from La Plata. It stands on very uneven ground at the skirts of mountains, which are watered by the little river Guatanay, which, indeed, hardly exists except in the months of January, February, and March, its waters being through the other months of the year almost dried up, though the little that remains in it may still serve, in some degree, to irrigate the neighbouring plains. Most of the houses are of stone. They are well constructed, laid out in regular proportions, and covered with tiles of a bright red colour. The apartments are spacious and finely decorated; the mouldings of the doors are gilt, and the other ornaments and furniture are in a style corresponding to the elegance of the buildings, and the good taste for which the inhabitants are so generally noted. The population of this city is estimated by Alcedo at 26,000. It suffered, however, greatly by a pestilence in 1720, and of late years it has, very obviously, been in a declining state. Three fourths of the inhabitants are stated to be Indians, who are occupied chiefly in the manufacture of baize, cotton and leather, likewise of ordinary cloth, and a kind of linen used chiefly as clothing by the poor, saddles, floor-carpets, galloons of gold, silver, and silk, parchment, and other preparations from various skins. The natives, who are of an ingenious disposition, are also said to have a taste for painting, and to excel in the arts of embroidery and engraving. They are, in general, a very diligent, industrious people. The government of the city was, after the time of the conquests made by the Spaniards, vested in a secular cabildo, composed of two ordinary alcaldes, a royal ensign, an alguazil-mayor, a provincial alcalde, a depositor-general, twelve perpetual regidors, two alcaldes of the inquisition, and a regidor nominated annually with the title of judge of the natives, who was entrusted with the causes of the Indians: these having also a protector nominated every two years by the viceroy of Lima. This cabildo derived from the grant of the emperor Charles V. the same privileges which were enjoyed by the cabildo of Burgos. The principal acting magistrates were a corregidor and two alcaldes, who, according to the prevailing custom in all the cities of South America, were chosen from among the chief nobility. The noble Spanish families which had their residence in this city, were formerly very numerous; indeed it was very full of Spaniards of all descriptions while it continued to be in a prosperous and flourishing condition. In 1784, the office of corregidor was extinguished here, when his majesty established an intendant and governor vice-patron; and in 1787, the tribunal of royal audience, composed of a president, four oidors, and a fiscal. There are three colleges in Cusco. In one of these, distinguished by the name of San Antoin Abad, there is a seminary for the service of the cathedral, in which are taught Latin, the sciences, and divinity. Another of them, that of San Bernardo, which was founded by a Vizcayan for the sons of the conquerors, was formerly under the direction of the regulars of the society of Jesuits, and young men of fortune resorted thither to be instructed by these fathers. It is at present under an ecclesiastical rector. The branches of knowledge taught here were, as at the last mentioned seminary of education, grammar, philosophy, and theology. The third, called St Francis de Borja, belonged also to the Jesuits, and was appointed for the education of the sons of caziques or Indian princes, where they were initiated in their letters; and such of them, at least, as shewed any disposition towards that science, in the rudiments of music. By the two former of these colleges, all degrees are conferred below that of doctor; and they have been erected into universities. The courts of justice established in this city are, one for the revenue which consists of two judges, a court of inquisition, and one of the croisade, together with the other offices usually found in the large cities in this quarter of the world.

Cusco is an episcopal city, and its bishop is suffragan to the archbishop of Lima. The members of the cathedral chapter, besides the bishop, are five dignitaries, viz. the dean, archdeacon, chanter, rector, and treasurer; two canons by competition; a magistral and penitentiary; three canons by presentation; and two prebendaries. The cathedral is a large, rich, and handsome edifice, built entirely of stone. It is smaller than that of Lima, but is by some preferred to it in point of the architecture. The three curacies in the chapel of the Sagrario belonging to it, are served by the same number of priests, one of whom is for the Indians and negroes of the parish, and the other two for the Spaniards. There are, besides this, eight parishes in or belonging to the city; one of them, however, situated from it at the distance of one, and another of two leagues. The parishes within the city, are those of Neustra Senora de Belen, San Christoval, Santa Ana, San Blas, Santiago, and the Hospital. The two others are those of San Geronimo and San Sebastian. There are here likewise nine convents of different religious orders. One is that of the Dominicans, the principal walls of which were formerly those of the temple of the sun, and of which the high altar afterwards came to occupy the place where once there had been a golden image of that planet. The others are two belonging to the Franciscans; one to the Augustines, and one to the Fathers of Mercy, which are severally the heads of their respective orders in the province. One of the observers, another of the recoletans, and two colleges which belonged to the regulars of the extinguished company of the Jesuits, but of which the principal in the part lying towards the east is now destined for an armoury, and the other at the back of this, in which was the house for noviciates and students, is occupied as barracks for the troops; to all which may be added, the chapel of ease to the cathedral. The convent of San Juan de Dios, and that of the Bethlemites, which are both very large, are now used as hospitals for the sick; the latter being appropriated to the Indians, who are there treated with the greatest care and tenderness. Altogether there are four hospitals in the city. The first and most ancient of these is that of the Espiritu Santo. It is into it that Indians of both sexes are received. The patronage of it is vested in the secular cabildo; and it is governed by a junta of 33 persons, the president of whom, the alcalde, has the first vote, and after him the administrator or first brother. There are two chaplains belonging to this institution, and it has very ample revenues, one of the sources of which consisted in the duties paid upon all effects passing over the neighbouring bridge on the Apuremac. Till the year 1763, these droits had belonged to the royal exchequer, at which time, at the instance of the king's ensign, Don Gabriel de Ugarte, they were conceded by the king to the hospital, together with the right and property of the bridge, in redemption of some crown grants that had been left to the hospital by Don Rodrigo de Leon in Seville. Having thus become very rich, it has now no less than 250 beds. A jubilee has been granted to its chapel by the apostolical see, which is celebrated at the octave of Pentecost with much solemnity, and by an unusually great concourse of people; this having once, indeed, been the best observed jubilee of any in America. The hospital belonging to the religious order of San Juan de Dios is for men, and has 50 beds. The third hospital, called that of Nuestra Senora de la Almudena, is for all descriptions of individuals, and has also 50 beds; and the fourth, known by the name of San Andres, has 30 beds, which are appropriated to Spanish women. The nunneries of the city are those of St Clare, St Catherine, the barefooted Carmelites, and a Nazarene sisterhood. That of St Catherine is founded where the Incas kept the virgins dedicated to the sun. There are still other religious houses in this place, the principal of which are those of Nuestra Senora del Carmen of Santiago, and of San Blas.

The city of Cusco, as it is the most ancient, so, in point of extent, it is still the second in the viceroyalty of Peru, being only inferior to Lima; and so little inferior, that as the latter may be called the maritime capital of that viceroyalty, the former may be considered as its inland metropolis. Proudly situated amongst the surrounding Andes, and boasting of an origin that reaches back to a remote antiquity, it may justly lay claim to the dignity of a capital. Its north and west sides are surrounded by the mountain of the Fortress, and others, called by the general name Sanca; on the south it borders on a plain, in which there are several beautiful walks. The fortress which gives its name to the mountain, situated towards the north and the west of the city, is still to be traced in its ruins. These occur in the heights contiguous to the northern part of the city, and are the remains of the famous fort built by the Incas for their defence. Their design when they erected this edifice, appears to have been to inclose the whole mountain with a prodigious wall of such construction, as might render the ascent of it absolutely impracticable to an enemy, at the same time that it might be easily defended from within. This wall was entirely of freestone, and, like all the other works of the Incas, was strongly built, being particularly remarkable for its dimensions, and the magnitude of the stones of which it is composed, as well as the art with which they were combined. The stones, which form the principal part of the work, are indeed of such vast size, that it is difficult to conceive how they could have been brought thither from the quarries by the bare strength of men, unassisted by the use of machines. One of them, which is still lying on the ground, and which seems not to have been applied to the use intended, is called La Cansada, or the troublesome, in allusion probably to the labour with which its removal was effected. The interstices between those enormous masses were filled with smaller stones, which are so closely joined, that a very narrow inspection is necessary for perceiving that the whole is not a single block of stone. It may well appear surprising, how materials so vast and shapeless, and of so irregular a superficies as those which enter into this building, could be knit together, and laid one upon another with such nicety, independently of the use of mortar or any other combining substance; and yet more, without the knowledge, on the part of those by whom the building was erected, even of iron or steel, or the simplest of the mechanic powers. The outward wall of this fortress is still standing, but the internal works, which consist of apartments and two other walls, are for the most part in ruins. A subterranean passage, of singular construction, led from the fortress to the palace of the Incas. In these the walls were cut very crooked, admitting for a certain space only one person to pass at a time, and this sidewise, while shortly afterwards two might pass abreast. The egress was by a rock worked in the same narrow manner on the other side; the whole being upon a plan, which, by enabling a single person to defend himself with ease against a great number, seemed well calculated to afford security against any sudden assault. The whole of these ruins, together with the fragments of a pavement of stone built also by order of the Incas, and which led to the place where Lima now stands, are certainly no mean monuments of ancient art. The baths also, of which the one is of cold and the other of warm water, are not undeserving of attention.

Cusco is, in point of antiquity, coeval with the empire of the Incas. It was founded by the first Inca, Manco Capac (*i. e.* rich in virtue,) as the seat and capital of his empire. This prince is supposed to have reigned in the 12th or 13th century. Having peopled the city with the first Indians who voluntarily submitted to him, he divided it into two parts, which he called Hanam Cozco and Hurin Cozco, or High and Low Cusco, the former having been occupied by people whom the emperor had himself assembled, and the latter by those, who had been prevailed upon to leave their wandering manner of life by his consort Mama-Oello. Himself and this lady, who was also his sister, he declared, previously to their marriage, to be the children of the sun. The first mentioned division of the city is that which forms the northern, the other is the southern part of it. The houses were at first low and small, like cottages, the principal edifice being the temple of the sun, founded by this prince, and in which he appointed virgins of the royal blood to serve that divinity. As the empire, however, increased, the buildings assumed a new appearance, the streets being proportionably large, wide, and straight, so that the Spaniards, when they landed in this quarter, were astonished at the extent and splendour of the city, particularly at the magnificence of the temple of the sun, the grandeur of the palaces of the Inca, the strength and massiness of the fortress, and at the general appearance of a pomp and richness not unworthy of the seat of so vast an empire. It was in the month of October 1534, that Don Francisco Pizarro entered this city, and took possession of it in the name of Charles V. emperor and king of Spain. This was followed by a siege on the part of Inca Manco, who laid great part of it in ashes, but, without dislodging the Spaniards, Manco Capac was crowned here with the permission of Pizarro; but having been afterwards defeated by the Spaniards, he retired to the mountains, and is supposed to have died about the year 1553.

The commerce of Cusco, consists chiefly in the very large quantity of sugar made in the neighbouring jurisdictions, the inhabitants of which have many sugar plantations. Of these, the most noted is that of San Ignacia de Pachacaca, in the boundaries of the jurisdiction of Abancay, and which formerly belonged to the regulars of the Jesuits. The mint, which was formerly established here, has for some years been abolished.

In a magnificent chapel of the cathedral, there is venerated a miraculous crucifix, which was presented by the emperor Charles V. and which is called De los Temblores, from its having been invoked here as a patron, in the tremendous earthquake which took place in the year 1590. There is also an image of Nuestra Senora de Belen, known by the name of La Lenda, (the beautiful,) the gift of the same royal hand.

The diocese comprehends 14 jurisdictions. The first of these is that which is called the jurisdiction of Cusco, and which extends to the distance of two leagues. In this district, the temperature of the air is various. In some parts, indeed, the cold is said to be intense, but generally both the heat and cold are very supportable. The very coldest parts produce good pasture for all sorts of cattle, while the vallies afford plenty of grain and fruits. In the intendancy of Cusco, as this district is now called, with its dependency of Carahuasi, the only mines which, in the Mercurio Peruano, are mentioned to have been found, are those of silver, nineteen in number, and which have been successfully wrought. The other jurisdictions of the diocese of Cusco, are those of Quispicanchi, of Avancay, of Paucartambo, of Colcaylares, of Chilques and Masques, of Colobambo, of Cances or Canches, or Tinta, of Aymaraez, of Chumbi-Vilcas, of Lampa, of Carabaya, of Asangaro and Asilo, and of Apolo-Bambu. See Ulloa's *Voyage to and History of South America*, vol. ii. &c. and Thomson's *Alcedo*, vol. i. (K)

CUSCUTA, a genus of plants of the class Tetrandria, and order Digynia. See BOTANY, p. 127.

CUSERUND, or CASEREUND, is a town of Persia in the province of Mekran. It is situated in a fertile valley about twenty-one miles broad, and is divided into two parts by a large river, which throws itself into the Indian Ocean near Gwuttar. The cultivated part of the surrounding territory is about eight miles in circumference, and has an abundant supply of water from twenty-five large springs on the north side of the valley. Wheat, rice, and dates are produced in the greatest plenty; and the county is under the dominion of an independent chief, who draws from it an annual revenue of nearly one thousand rupees. The town is defended by a mud fort, and contains 500 souls. East longitude 60° 43′, and North latitude 26° 20′. See Macdonald Kinneir's *Geographical Memoir of the Persian Empire*, p. 206. (*w*)

CUSSONIA, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 162.

CUSTOMS. See the statistical account of ENGLAND, in which this subject will be discussed.

CUSTRIN, or KUSTRIN, a strong and well built fortified town of Prussia, in the Newmark of Brandenburg. It is situated in the middle of a morass, at the confluence of the Warther and the Oder. The road which leads to Custrin from the circle of Lebro, is a fortified dyke or causeway about four miles long, and having no fewer than 36 bridges in that space. The road towards the Newmark is another causeway, and has only seven bridges.

Custrin is strongly defended both by art and nature. There are only about 200 houses within the walls, but the suburbs are more extensive and more handsome than the town itself. The principal public buildings are four churches, three magazines, and two hospitals. The magazines and arsenals are particularly worthy of notice. The inhabitants are much addicted to agricultural pursuits; but the sandy and marshy nature of the soil, prevent them from carrying on any trade in the productions of their territory. They obtain, however, great abundance of fish from the lakes and marshes; and after supplying their own wants, they export every year great quantities of salted fish. In the reign of Frederick II. several of the marshes were drained, and converted into rich meadows.

This town was burned by the Russians in 1739, although it was not taken. In 1758, the Russians reduced it to a heap of ruins, but they were still unable to take the town. In 1806, it surrendered by capitulation to Marshal Davoust, and the garrison, consisting of 4000 men, were made prisoners of war. It is at present (1814) besieged by the allies, and must speedily fall into their hands. (π)

CUTANEOUS DISEASES. See MEDICINE.

CUTCH GUNDAVA, a district of Persia, which will be described under the head of MEKRAN, the province in which it is situated.

CUTCH, GULF OF, is an extensive gulf of the Indian Sea, formed by the coast of Cutch to the north, and the coast of Guzzerat to the south. It extends a considerable distance to the eastward, and at the head of it is a low barren track, which the sea inundates during the monsoon. It is said to communicate with the river Ram in the Gulf of Cambay, and thus to form the province of Guzzerat into an island. This gulf contains numerous shoals, and is very imperfectly known. The capital of Cutch is Bhooj, which is about 25 miles to the north-west of Muddi. Muddi, or Musher Maundvee, or Mandivee, is the great port of Cutch, and is situated in east longitude 69° 25′, and north latitude 22° 50′. It is a large town, and well fortified, but the houses are built merely of mats and bamboos. A considerable trade is carried on between Muddi and Bombay, and also to the Persian Gulf. Cotton is the principal article of produce, but it is inferior to that which grows in Surat and the Gulf of Cambay. The following is a list of the exports and imports in 1805, from the coast of Scindy and Cutch to the British settlements in India, as given by Milburn in his Oriental Commerce.

Exports in 1805.	Sicca Rupees.
Cotton	1,585,520
Ghee	440,709
Grain	267,644
Oil	45,477
Piece goods	54,798
Seeds	59,853
Kismisses,	29,791
Indigo	12,476
Sharks' fins	8,609
Shawls	11,356
Drugs	32,655
Sundries	97,303
Total amount of exports to India in sicca rupees	2,646,191

Imports in 1805.	Sicca Rupees.
Piece goods	117,917
Pepper	119,723
Raw silk	129,395
Sugar and jaggery,	545,999
Betel nut	38,218
Copper	80,037
Cochineal	18,231
Cocoa nuts	48,355
Coir	30,099
Cardamoms	15,098
Carry forward	1,143,072

Cutting ‖ Cyanometer.

	Sicca Rupees.
Brought forward	1,143,072
Drugs	47,431
Grain	54,143
Iron	24,302
Steel	23,518
Japan wood	11,554
Tutenague	16,636
Tin	19,365
Spices	15,914
Sundries	81,640
Treasure	250,370
Total amount of imports from India in sicca rupees	1,687,945

See Guzerat and Scindy. (*j*)

CUTTING Engine. See Horology.

CUXHAVEN. See Hamburg.

CYAMUS. See *Nelumbium*, Botany, p. 239.

CYANEAN Isles. See Black Sea.

CYANELLA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 189

CYANOMETER, from κυανος, *blue*, and μετρον, *a measure*, is the name of an instrument, or rather of a method invented by M. de Saussure for estimating the intensity of the blue colour of the sky. A circular band, or zone, made of thick paper or pasteboard, is divided into fifty-one parts, each of which is painted with a different shade of blue, varying by gradual tints from the deepest blue, formed by a mixture of black, to the lightest, which is formed by a mixture of white. This coloured zone is then held in the hand of the observer, who notices the particular tint which corresponds to the colour of the sky. The number of this tint, reckoned from the greatest, will mark the intensity of the blue colour of the sky at the time of observation.

Saussure's cyanometer.

This instrument has been used not only by Saussure, but also by the celebrated traveller Baron Humboldt, and by M. Depons, to whom we are indebted for the three following results:

General intensity of the blue colour of the sky in Europe	14°
Do. do. at Caraccas	18
Do. do. at Cumana	24

Various opinions have been entertained respecting the cause of the blue colour of the sky. Fromondus attributed it to a mixture of light with the black space beyond our atmosphere. Faber supposes it to arise from the reflexion of the light by particles floating in the air. Funccius, who wrote a treatise on the subject, asserted, that the blue colour was a mixture of much shade and little light. Otto Guericke maintained, that white and black, when mixed together, will form a blue like that of the sky; and the same vague notion received the support even of Wolfius and Muschenbroek. Dr Eberhard imagines, that the air has a proper colour of its own, in consequence of *refracting the blue rays more than others*. It was reserved, however, for M. Bouguer to assign the most probable reason for the blueness of the sky. The red rays being less refrangible than the blue ones, and less apt to be obstructed or thrown back in their progress through an imperfectly transparent medium, will consequently force their way through the atmosphere, while the blue rays, having less power to overcome the resistance to which they are exposed, will be reflected, and, of course, give the sky a blue colour.

This opinion, however, though rendered probable by many considerations, still required the evidence of demonstration, which we think it has lately received. "We have already seen," says Dr Brewster in his *Treatise on New Philosophical Instruments*, p. 349, "that the singular decomposition of light produced by the intervention of a plate of mica, is exhibited only where the transmitted rays have been previously polarised. This alternation of the prismatic colours, therefore, may be assumed as a decisive test, that the light by which they are formed has received, either wholly or partly, the character of polarisation; and by thus distinguishing *reflected* from *direct* light, it enables us to account for several interesting phenomena which have been only hypothetically explained.

Cyanometer.

"When we examine the light of the clouds by a prism of Iceland spar, and interpose a plate of mica, the alternation of the prismatic colours is distinctly visible, although none of the two images formed by the spar vanishes in every quadrant. It follows, therefore, that the light of the clouds has been partly polarised by reflexion

"When the *blue light* of the sky is examined in a similar manner, the play of the prismatic colours is still more brilliant than in the preceding experiment, and one of the images suffers a visible diminution of brightness at every quarter of a revolution. Hence we may conclude, *that the blue light of the sky has experienced a partial polarisation, and that it is reflected from the atmosphere with which the earth is surrounded*."

M. de Saussure found, that the intensity of the blue colour increased with the elevation above the level of the sea; and it has also been observed, that the intensity of colour is diminished as the quantity of aqueous vapour is increased. Hence the measures taken with the cyanometer are supposed to indicate the quantity of water actually dissolved in the air.

Another cyanometer, obviously more accurate than that of Saussure's, and more deserving of the name of an instrument, has been constructed by the writer of this article. It consists of two plates of glass, about twelve inches long, joined together at one end, so that their surfaces may form an angle of from 12° to 20°. These plates form two of the sides of a prismatic vessel, which is filled with a blue fluid, having such an intensity, that the blue colour near the top of the vessel, where the distance of the plates is small, is less than the minimum blue of the sky, while the intensity of the blue colour at the bottom of the vessel exceeds the deepest tinge which is ever found in the atmosphere. Between these two extremes there is a regular gradation of tints, and by a proper adjustment of the length of the plates to the angle which they form, and to the intensity of the blue fluid, a scale of convenient magnitude may be obtained. In using this instrument, a white circular spot may be made to move upon a black ground, so as to be seen through the fluid in any part of its progress from the one end to the other of the prismatic vessel. The light which illuminates the white circular space, may be either common light, or, by making the white spot move in contact with one of the glass plates, the light will first pass through the fluid to the white spot, and then be reflected back again to the eye. In this last case, the intensity of the blue colour will be very great.

New cyanometer.

By using four, six, eight, ten, or twelve glass plates, a prismatic vessel with several sides may be constructed; and by making the distance of each pair of plates different, and altering the angle which they form, a scale of any magnitude may readily be obtained. (*o*)

CYATHODES, a genus of plants of the class Pentandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl. et Ins. Van. Diem.* p. 537; and BOTANY, p. 174.

CYAXARES. See MEDIA.

CYBELE. See MYTHOLOGY.

CYCAS, a genus of plants of the class Diœcia, and order Polyandria. See BOTANY, p. 338.

CYCLAMEN, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 136.

CYCLE. See CHRONOLOGY.

CYCLE, in Music, is a term used by Dr Robert Smith, in his *Harmonics*, for certain determinate periods, or series of pulses or vibrations, excited in the air by the consonance or sounding together of two musical sounds. These cycles he distinguishes into four kinds, (p. 56. 2d edit.) viz. 1st, *Simple* cycles, generated when the least or lowest terms of the ratios, expressing intervals, differ only by unity, as $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}$, &c. 2d, *Complex* cycles, when these terms differ by more than 1, as $\frac{1}{3}, \frac{2}{5}, \frac{5}{9}, \frac{27}{32}, \frac{8}{15}$, &c. 3d, *Short* cycles, formed by the pulses of perfect consonances, or those whose ratios are truly expressible, without using very large numbers, as $\frac{1}{2}, \frac{3}{5}, \frac{8}{9}, \frac{80}{81}$, &c. And, 4th, *Long* cycles, of the pulses of imperfect unisons, or other consonances, which are not expressible but by very high or large numbers, as $\frac{292\,2977, \&c.}{292\,3003, \&c.}$ to 49 places of figures, which answers to *m*, the least known interval. See our Table in Plate XXX. Vol. II.

The complex long cycles of imperfect unisons, may be ever so long, infinite, or impossible, and yet the indeterminate periods of their pulses, which excite the determinate sensation of these imperfect unisons, will have each a finite or determinate *limit*, to which they approach, p 101; and hence Dr Smith imagines, that the identity of the tone of imperfect unisons, when held out or sounded together sufficiently long upon an organ, may be accounted for, p. 102. And hence the difficulty, or uncertainty, in transferring unisons from a monochord to a piano-forte, or from a standard pipe to an organ, with the requisite accuracy. (*g*)

CYCLOID. See EPICYCLOID, MECHANICS, and PENDULUM.

CYDER is the name of a fermented liquor, which is made in England in great quantities from the expressed juice of apples. After the apples are gathered from the trees, they are ground into what is called pommage, either by means of a common pressing stone, with a circular trough, or by a cyder mill, which is either driven by the hand, or by horse-power. When the pulp is thus reduced to a great degree of fineness, it is conveyed to the cyder press, where it is formed by pressure into a kind of cake, which is called the cheese. This is effected by placing clean sweet straw, or hair-cloths, between the layers of pommage, till there is a pile of ten or twelve layers. This pile is then subjected to different degrees of pressure in succession, till all the *must*, or *juice*, is squeezed from the pommage. This juice, after being strained in a coarse hair sieve, is then put either into open vats or close casks, and the pressed pulp is either thrown away, or made to yield a weak liquor called *washings*.

After the liquor has undergone the proper fermentation in these close vessels, which may be best effected in a temperature of from 40° to 50° of Fahrenheit, and which may be known by its appearing tolerably clear, and having a vinous sharpness upon the tongue, any farther fermentation must be stopped by racking off the pure part into open vessels, exposed for a day or two in a cool situation. After this, the liquor must again be put into casks, and kept in a cool place during the winter. The proper time for racking may always be known by the brightness of the liquor, the discharge of the fixed air, and the appearance of a thick crust formed of fragments of the reduced pulp. Mr Knight is of opinion, that the liquor should always be racked off anew, as often as a hissing noise is heard.

When a favourable vinous fermentation has been obtained, nothing more is required than to fill up the vessels every two or three weeks, to supply the waste by fermentation. On the beginning of March, the liquor will be bright and pure, and fit for final racking, which should be done in fair weather. When the bottles are filled, they should be set by uncorked till the morning, when the corks must be driven in tightly, secured by wire or twine and melted rosin, or any similar substance. Such of our readers as wish for more copious details respecting the process of cyder-making, will find abundance of information in the agricultural surveys of the English counties, where cyder is made in great quantities. See particularly Vancouver's *Survey of Devonshire*; Rudge's *Agricultural Survey of Gloucestershire*; and Duncomb's *General View of the Agriculture of the County of Hereford*. (*j*)

CYDONIA, a genus of plants of the class Icosandria, and order Monogynia. See BOTANY, p. 233.

CYGNUS. See ASTRONOMY, vol. ii. p. 755.

CYLINDER. See GEOMETRY.

CYLINDER BORING. See BORING MACHINE.

CYLISTA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 281.

CYMA, CYMATIUM, or CIMA. See CIVIL ARCHITECTURE, Vol. VI. p. 599.

CYMBASIA, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 255.

CYMBIDIUM, a genus of plants of the class Gynandria, and order Diandria. See BOTANY, p. 314.

CYNANCHUM, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 157.

CYNARA, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See BOTANY, p. 293.

CYNICS. See ANTISTHENES and DIOGENES.

CYNODON, a genus of plants of the class Triandria, and order Digynia. See BOTANY, p. 115.

CYNOGLOSSUM, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 135.

CYNOMETRA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 210.

CYNOMORIUM, a genus of plants of the class Monœcia, and order Monandria. See BOTANY, p. 320.

CYNOSIUM, a genus of plants of the class Triandria, and order Digynia. See BOTANY, p. 109.

CYPERUS, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 98.

CYPHIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 115.

CYPRÆA. See CONCHOLOGY, p. 83.

CYPRINUS. See ICHTHYOLOGY.

CYPRIPEDIUM, a genus of plants of the class Gynandria, and order Diandria. See BOTANY, p. 316.

CYPRUS, a large island in the Levant, and situated in north latitude 35°, and east longitude 33°. It is about

Cyprus.

Ancient history of Cyprus.

70 leagues in length from east to west, and about 30 in its greatest breadth from north to south; and lies nearly at an equal distance from Caramania on the north, and from Syria on the east. It was even supposed by the ancients to have once formed a part of that country, and to have been detached from it at an early period of the world, during some violent convulsions of nature, as Sicily from Italy. According to some authors, this island received its name from the abundance and beauty of the copper which it contains in its bosom, and which being found formerly in metallic masses, and being less difficult to melt than iron, was employed by the ancients for fabricating their implements of agriculture, and their weapons of war. Others again maintain, that the word Cyprus is borrowed from a shrub, called by the Greeks Kupros, and by the Hebrews Kopher. It is the *henne* or *hanna* of the Arabs, the *kanna* of the Turks, and the *Lawsonia inermis* of Linnæus. From this tall shrub, which abounded in the island, its ancient inhabitants made an oil of an exquisitely delicate flavour and taste, which was an article of great importance in their commerce, and is still in great repute among the eastern nations. Besides this, however, it had a variety of other names, a long enumeration of which is given by Pliny, (*Hist. Nat.* lib. v. cap. 31.) Among these, *Macaria*, or the Fortunate Island, appears to have been the most appropriate, as there were few places in the world that could compare with it, in fertility of soil, in mildness of climate, in the beauty of its plains, and in the richness of its productions.

Our readers need not be informed, that this island was in a peculiar manner consecrated to Venus. This goddess, the mother of the Graces, the Loves, and the Pleasures, was said to have sprung from the froth of the sea near this island, to which she was wafted by the Zephyrs, and received on the sea-shore by the Seasons, the daughters of Jupiter and Themis. She was called by the poets, not only the Cyprian but the Paphian queen, because she was worshipped by the whole island, but in particular by the inhabitants of Paphos, one of its most populous cities on its western coast, where an hundred altars daily smoked with male animals offered in sacrifice, and perfumed with the richest odours of Arabian frankincense.

Eratosthenes affirms, that the Phœnicians first discovered this island about 1045 years B.C. But to reconcile this account with what Josephus relates, we must admit, that it was then inhabited by the descendants of Cittim, the grandson of Japhet, who first peopled the island, and laid the foundation of Citium, the oldest of its cities. The aborigines, however, seem to have lived entirely upon the spontaneous productions of the earth, and by hunting, and to have made no advances towards civilization. The Phœnicians no sooner landed, than they began to level the immense forests which covered the whole country; to employ the wood in melting the copper which they knew how to manufacture, and to cultivate the grounds which they had cleared. The government which they established was monarchical, and the island was divided into four provinces, or rather dynasties; for each seems to have been independent, and to have had its own king. Salaminia, on the east; Amathusa, on the south; Papphia, on the west; and Lapytha, on the north. The Phœnicians not only introduced among them the arts, but also the sciences which they possessed; and though, in process of time, colonies from Greece and Ethiopia settled there, and no doubt blended their original manners and customs with the manners and customs which prevailed in their new habitations, yet still the strong features of their civil and religious institutions evidently prove that they were derived from the same Phœnician source.

Cyprus.

Ancient history of Cyprus.

The annals of this country are at first obscure and uninteresting. Cinyras, the son of Paphos, and grandson of Pygmalion, is the first who is said to have erected his throne at Paphos, and to have transmitted to his son Adonis, the sceptre of the Paphian state. The names of his other descendants are unknown; and from them our attention is drawn to Teucer, who, after the fall of Troy, laid the foundation of Salamis, and assumed the sovereignty of a new dynasty, which he called Salaminia, and which soon surpassed every other in the island. His immediate descendants left not the wreck of a name for many generations. About 525 years B. C. Nicocreon is mentioned only as the father of Enelthon, who succeeded him. Enelthon is said to have been the first who yielded the independence of his country to the Egyptians, and afterwards to the Persians under Cambyses. After this, Siromus, Chersis, and Gorgus, successively wielded the sceptre of Salamis, as tributaries of Persia. Onesilus, the brother of the latter, indignant at the disgrace which his country endured from this subjection, conjured Gorgus to throw off the yoke of Persia, and vindicate the dignity of his throne; and enraged, because the prudence or cowardice of his brother shrunk from the danger, he drew a number of his countrymen to enter into a conspiracy; drove his brother from his kingdom, who fled to Persia; roused the other states of Cyprus to unite against the common enemy; persuaded the Ionians to join him with their fleet; and, at the head of the confederates, met the powers of Persia on the plains of Salamis. The conduct of Onesilus on that bloody day, though it could not vindicate his usurpation, proved that he was worthy of a better cause. With his own hand, he slew the leader of the Persians; led his countrymen, with equal skill and courage, to brave and to sustain the superior power that opposed them; and when the revolt of Stesenor, King of Curium, and part of his own forces, snatched from his hand a victory which his valour had almost purchased, he fell on the field amidst heaps of his enemies. His brother again mounted the throne, and was succeeded by his son Nicrocatus; he by his brother Timarchus; and he by Evagoras I. the son of Nicocrates. In his reign, the Athenians formed the glorious design of confining the Persians to their own dominions; invited all the states subjected to their power to vindicate their independence; and sent Cimon, with a fleet of 200 vessels, to drive them from Cyprus. Cimon, worthy of the work assigned him, not only expelled the Persians from many of the Cyprian cities, but attacked Artabazus, who commanded their fleet of 300 sail; took 100 of his ships, destroyed many more, and pursued the rest to the shores of Phœnicia. On his return he landed his forces in Cilicia, defeated Megabazus, at the head of 300,000 Persians; and again embarking his hardy veterans, set sail for Cyprus, and landing there, laid siege to Citium. Evagoras, however, dead to his own glory and to the liberty of his country, joined the Persians; and endeavouring to raise the siege, was defeated with a great slaughter. Artaxerxes, however, tired of a destructive war, renounced his claims upon Greece and Cyprus; and thus, the kings of the latter, received that freedom of which they had proved themselves unworthy. A short time after this, Evagoras was driven from the throne by his nephew Protagoras; and under him and his son Nicocreon II. famous for his cruelty, the Cyprians enjoyed independence, till Artaxerxes Mnemon again subjected them to the Persian yoke. Niocles, who succeeded Nicocreon, was expelled from his country by one Abdymon, a stranger, who had been kindly received and entertained by the monarch whose throne he usurped. The son of Niocles, Evagoras II. endowed with every quality of body or of mind that could form him for sovereignty, rose up to avenge the wrongs of his father, and to vindicate to himself the crown of his ancestors. But whilst he was preparing for the attempt, one of the principal citizens struck the blow, and seized the sceptre of Abdymon, whom he had murdered. But the son of Niocles, returning from exile, roused the Cyprians, who flocked to his standard; delivered his countrymen from the usurper, under whose cruelty they groaned, and expelled the Persians who endeavoured to support him. Flushed with his success, he attempted to reduce the whole island under his subjection, and almost accomplished his ambitious design. But the Amathusians, Solians, and Citians, who only braved his arms, implored the assistance of the Persians; and the Persians, remembering former injuries, promised their aid, made peace with the Greeks, and collected their powers to expel him from his country. Evagoras saw the storm that his ambition had raised, and prepared to arrest it in its course. The Athenians, whom, after their defeat at Ægospotamos, he had protected, the Egyptians, Lybians, Arabians, Tyrians, all who were at war with Persia, he invited to his assistance; and when the fleet of the enemy threatened his shores, and poured upon the island 300,000 men, with Tiribazus at their head, to sweep the interior country, he dared to meet the overwhelming torrent, and entirely dissipated its enormous force. But when he attacked them by sea, he lost the battle, but not his fame. After performing prodigies of valour, he found himself not only blocked up and besieged in Salamis, but obliged to yield up, at the command of Persia, the conquests which he had made, though he bravely preserved the independence of his paternal dominions. Being soon after murdered by Thrasidæus, one of his eunuchs, his son Niocles II. who succeeded, performed nothing to arrest our attention: but his friendship for Isocrates, who lived during his reign, and experienced his bounty, will preserve his name from oblivion. At his death, his son Evagoras III. ascended the throne, but the government was soon wrested from him by his uncle Protagoras, who seized the sceptre, and joining the Egyptians and Phœnicians, attempted to throw off the Persian yoke. In consequence of this, Ochus espoused the cause of the exiled monarch, joined his Persians with Phocion, who commanded the Greek mercenaries, made a descent upon the island, and besieged Salamis. But the kings of Cyprus, nine in number at that time, united under Protagoras to vindicate their freedom; and the king of Persia, meeting with greater resistance than he expected, and bent upon the reduction of Egypt, granted their demands, and left Protagoras in possession of the throne. From this period, the kings of Cyprus seem to have slumbered in indolence, under the shade of Persia, till Alexander reduced the island to subjection. At his death, it composed part of the kingdom of Antigonus; but whilst that prince was engaged in war with Cassander, Ptolemy, the son of Lagus, made a descent upon the island, and forced its kings to yield to his power. At this time, Niocles, who had the chief power amongst those who retained some shadow of royalty in the island, entered into an agreement to assist Antigonus to recover it, but being discovered, he slew himself to avoid the punishment which Ptolemy had prepared for him; and his wife, Axiothea, after slaying all her daughters, imitated the example of her husband, lest she should fall into the hands of the enemy, and thus extinguished the royal race of Teucer. To wrest the island from Ptolemy, Demetrius, the son of Antigonus, at the command of his father, collected an army in Cilicia, landed upon the shores of Cyprus, stormed some of the inferior cities, advanced to form the siege of Salamis; dissipated, in a fierce battle, the forces of Menelaus, the brother of Ptolemy, who endeavoured to stop his progress; pursued the vanquished to the gates of Salamis, and invested the city. But hearing that Ptolemy, to support his brother, sailed from Egypt with 140 ships of war, 200 transports, and ten thousand soldiers, he took the command of his fleet, consisting of 108 ships; gave battle to the enemy, who had reached the coast; and after a dreadful engagement, which was long doubtful, he gained a complete victory. Upon this, the whole island submitted to the conqueror, and his father, Antigonus, assumed the title of king. At his death, the title and authority descended to Demetrius; but at the end of eleven years, whilst he was engaged in a war with the Athenians and Lacedemonians, Ptolemy landed upon the island, and took possession of the capital, before Demetrius could be informed of his design. After it had remained for some time subject to the kings of Egypt, it seems to have been wrested from them by Syria; but if this was really the case, the Egyptians soon recovered it, and kept the possession till the death of Ptolemy Lathurus. At his death, his two sons divided his dominions, and the kingdom of Cyprus fell to Ptolemy. This prince, refusing to advance money to purchase the liberty of Clodius, a Roman nobleman who had been taken by pirates, became the object of his hatred and revenge. After having acquired his liberty, Clodius was elected tribune of the people; and, prompted by resentment, he procured a decree, which the senate did not oppose, that Ptolemy, by his vices, was unworthy of his throne, and that the kingdom of Cyprus belonged to the Romans. The pretence under which the Romans veiled their injustice, was, that Alexander, late King of Egypt, had, at his death, bequeathed his dominions, including Cyprus, to the Romans. This donation, though mentioned at the time, had passed unnoticed on account of its injustice, but was now revived to gratify the vengeance of an individual, and the rapacity of the republic. Cato was commissioned to execute this disgraceful decree; and it deserves to be mentioned, that this person, who has been extolled as the most virtuous of the Romans, performed, without remorse, the iniquitous part which was assigned to him; took possession of the island without resistance; and after driving a king, who had been called the friend and ally of the Roman people, to lay violent hands upon himself, seized upon his treasures, amounting to 7000 talents, or about £1,356,250 sterling, and conveyed them to Rome. Thus, then, in the year 58 B. C. the sovereignty of Cyprus was for ever extinguished, and the island became a part of the Roman empire. The history of Cyprus, since that period, is naturally involv-

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ed in that of the different powers to which it became subject. It was conquered by the Saracens from the Europeans of the west; but fell under the dominion of the Venetians during the Crusades. The Venetians were in their turn driven from it by Sultan Selim in 1570, since which time it has constituted a part of the Ottoman Empire.

General description of the coast.

At a distance, Cyprus appears mountainous, rising in height towards the east; but upon approaching the shore, villages and some fertile plains are seen skirting the foot of the hills, some of which are craggy, and of considerable height. It is rounded on the south-west, and gradually narrows, until it draws out into a long point, terminated by Cape St Andrew on the east. On coasting along the southern shore from this point, the town of Famagusta appears, lying at the bottom of a large gulf of the same name. It is supposed to have been built upon the ruins of the ancient Arsinoe, and is defended by some fortifications which had been erected by the Genoese and Venetians, but which are now falling fast into decay. Its harbour is safe but small, and half choked up with sand. Proceeding west, we find the gulf of Larnica, which affords an excellent road-stead for vessels of any size, and which is the most frequented in the island. The town, (the ancient Citium), from which it takes its name, stands at some distance from the sea. It is the residence of the European consul and merchants, and is still a place of considerable trade.

Famagusta.

The situation is rather unhealthy, being surrounded by arid and barren plains, and exposed to a suffocating heat. These plains, however, were formerly covered with forests of olive trees; and, in the neighbourhood are still to be seen immense cisterns, which had been erected for the purpose of preserving the oil which they yielded. With the exception of the gardens adjoining the town, scarcely a vestige of cultivation remains. These gardens, however, are very beautiful. Every house almost has its garden, which is enclosed with lofty walls, and contains every kind of delicious fruits and flowers. About a mile south, on the coast, is the town of Salines, which takes its name from a cluster of salt lakes in its vicinity. It is the port of Larnica, where the merchants have their warehouses, and where almost all commercial transactions are carried on. The southern promontory of the island is a small peninsula, joined to the continent by a very narrow tongue of land. It was formerly named the promontory of Agrotiri, now Cape de Gatti, from the multitudes of cats which were kept by the monks who, in the 4th century, had permission to settle here, and also on Mount Olympus, upon condition of their keeping a great number of these animals for destroying the snakes which had almost entirely overrun the island. On doubling Cape de Gatti, the coast bends to the north-west, and a little more than half-way between this cape and cape St Epiphanes, the north-west part of the island, stands the small town of Baffa, (the ancient Paphos), which consists of the ruins of its former magnificence, a few mean Greek churches, some paltry houses, and a wretched fort. On the north side of the island, Cerina (formerly Ceraunia) is the only place worth mentioning, and its ruins also bear ample testimony to its past grandeur.

Salines.

Baffa.

Description of the interior.

The interior of the island is divided by a chain of mountains which runs lengthwise from west to east. The most remarkable of these is Little Olympus, so called to distinguish it from another mountain of the same name in Natolia; and also a still more famous one in Macedonia. Some of them exhibit curious forms, standing insulated, and having flat tops, resembling what are usually called table-mountains. Near the centre of the island, and in the middle of a vast and beautiful plain, stands Nicotia, the capital of Cyprus. The situation is agreeable. The soil around it is excellent, and is watered with abundant streams; and the town is surrounded by fine gardens. It is the residence of the governor, who now occupies one of the palaces of its ancient sovereigns. The palaces are remarkable for the beauty of their architecture, but are abandoned by their Turkish masters to the destructive hand of time. The fortifications of this town are still nearly entire, and although neglected, yet they surpass in beauty and magnificence those of almost every other city. The moat is half a mile wide, but is now dry, or at best but an unwholesome swamp; and a few pieces of artillery are now its only defence. The church of St Sophia, in this place, is a very superb and beautiful edifice. It is built in the Gothic style, and is said to have been erected by the Emperor Justinian, when he raised the church of the same name at Constantinople. It has three large naves; but the choir and the altars were destroyed when the city was taken by the Turks. Here the Christian kings of Cyprus were formerly crowned; and it still contains the tombs of the Lusignans, and of several ancient Cypriots and noble Venetians. It is now converted into a mosque. There is no other place in Cyprus worth our notice; and this island, which was formerly divided into nine kingdoms, and was so famous for its superb edifices, its elegant temples, and its riches, can now boast of nothing but its ruins, which will tell to distant times the greatness from which it has fallen.

Nicotia.

Climate.

The chain of mountains which intersects Cyprus, produces also a very material difference of temperature in the two divisions of the island. In the northern region, the heats of summer are tempered by the refreshing winds which blow from the high mountains of Caramania. These produce piercing colds during winter, and even preserve the snow on some of the highest spots during the greater part of the year. But on the south, the north winds are impeded by the mountain barrier; and the heats are increased by the reflection from the shelving rocks, which form the declivities of the hills, and from a soil so white that the glare is often sufficient to cause temporary blindness. The southern coast is also liable to hot winds from almost every point of the compass. These come from the parched deserts of Curdistan on the north-east, from the sands of Palmyra on the east, from the Great Desert of Arabia on the south-east, and on the south and south-west from Egypt and Lybia. During a squall from the north-east, Dr Clarke endeavoured to ascertain the temperature. "We found it so scorching," says he, "that the skin instantly peeled from our lips; a tendency to sneeze was excited, accompanied with great pain in the eyes, and chopping of the hands and face; and the mercury exposed to its full current rose 6° of Fahrenheit in two minutes, from eighty to eighty-six." The heats are sometimes so excessive, that persons going out without an umbrella are liable to suffer from a *coup-de-soleil*, or sun-stroke, a malady by no means uncommon in this island; and the inhabitants, especially of the lower class, in order to guard against it, wrap up their heads in a large turban, over which, in their journies, they place a thick shawl many times folded. They seldom, however, venture out of their houses du-

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ring mid-day; and all journies, even those of caravans, are performed in the night. Rains are also very rare in the summer season; and long droughts banish vegetation, and attract numberless columns of grasshoppers, which destroy the plants and fruits. Rivers are very scarce, and, indeed, the most of them are quite dry during the summer months. Sudden rain swells them into torrents; and they are supplied in the spring by the melting of the snow on the mountains.

Soil and agriculture.

The soil throughout the island is in general excellent. In some places it is a white marly clay, said to be exceedingly rich, and requires only the hand of cultivation, and the fostering care of a liberal policy, to make it yield the most abundant and luxuriant harvests. But its fertile plains are condemned to barren nakedness, by the tyranny and exactions of its government. The Greeks are so oppressed by their Turkish masters, that they dare not even cultivate the land, as the produce would instantly be taken from them; and their whole object is to collect together as much grain in the course of the year, as is barely sufficient to pay their tax to the governor, the omission of which is often punished by torture or by death. Wheat and barley were formerly principal articles of exportation from this island; but now scarcely sufficient is raised for the subsistence of the inhabitants. Its agricultural riches, however, though much neglected, and greatly reduced in quantity, are yet far from being inconsiderable.

Olive trees.

Olive trees were formerly very numerous in Cyprus, and the great quantities of oil which they produced, is attested by the immense reservoirs which still subsist in the environs of Larnica. It once formed a very important branch of commerce, but all that is now furnished is consumed in the island. The culture of the mulberry tree is also much abandoned, though still small woods of them are found in several places, and afford nourishment to a great number of silk-worms.

Bread tree.

The *careb*, or St John's bread tree, is more plentiful, and the long thick pods which it produces are exported in considerable quantities to Syria and Egypt. The succulent pulp which the pod contains, is sometimes used in these countries in place of sugar and honey, and is often employed in preserving other fruits.

Cotton.

The cotton of Cyprus is the finest, and brings a higher price than any in the Levant, or Archipelago; but the plains which were once covered with this plant, preserve only the shadow of its former culture.

Sugar canes.

The large plantations of sugar canes, which were reared with great success by the Venetians, and also the refining houses which they had erected, were burnt down or destroyed as soon as it fell into the hands of the Turks; and since that time, the culture of this plant has not been resumed. The gardens are, in general, full of all kinds of vegetables, particularly cauliflowers, which are here excellent; and abound with various sorts of flowers of the most brilliant lustre, and with aromatic plants, which diffuse their fragrance far around.

Fruits.

Apricots, plumbs, melons, cucumbers, and many different varieties of the gourd or pumpkin are produced in great plenty; and orange trees, lemon trees, pomegranate and other fruit trees, form groves around many of the habitations. Opium is cultivated at the foot of Mount Olympus; and madder, coloquintida, and soda, are gathered in several parts of the island. The forests, which are very abundant in the south-western district of the country, and likewise many places in the northern region, afford very fine wood for building and planks, and also plenty of tar and pitch; and the turpentine of Cyprus is equal to any in the world.

Forests.

Their chief attention, however, is given to the vine, which grows here in such perfection, that there is perhaps no place in the world where it yields such redundant and luscious fruit; and "the wine of this island," says Dr Clarke, "is so famous all over the Levant, that in the hyperbolical language of the Greeks, it is said to possess the power of restoring youth to age, and animation to those who are at the point of death." The best is the *Commanderia*, so named, because the district which produces it formerly constituted a part of the great commandery of the Templars and of the Knights of Malta, and is comprised between Mount Olympus and the towns of Limasol and Baffa. Limasol also produces the best Muscadine wine in Cyprus. They are both white wines, and when new have a slight violet tinge, which they lose by age, and then keep the colour of Madeira. The Commanderia is so strong, that it is preserved in casks, to which the air has constantly access, and may be kept in this way for any number of years. When it has stood a year, it is supposed to have passed the requisite proof, and then sells for about three-pence sterling the English pint. A very ancient custom prevails among the inhabitants. When a child is born, they bury large vessels filled with this kind of wine, which are not taken up but for the marriage festival of the same child. These being closely stopped, and preserved secure from the impression of the air, the wine is so improved, that it is considered as a great delicacy. All the wines intended for exportation are collected at Larnica, and kept there until they are shipped.

Cyprus.

Wines.

Mineralogy.

Though Cyprus be capable of the highest cultivation, and may be made one of the most productive islands of its size in the world, it is equally remarkable for the riches which it contains in its bosom. But these also are rendered useless by the despotism of the government, as all boring in search of mines is strictly prohibited. Gold mines were formerly wrought in this island, but they have been for ages abandoned, and the places where they were found cannot now with certainty be pointed out. Its copper was, in ancient times, the finest in the world, and its rich mines furnished the first blocks of that metal which were brought into use. The island was even distinguished by the epithet Ærosa, *Copper Island*; and the city Amathus, whose site is now occupied by Limasol, was characterised by Ovid as *gravida metallis*. These mines, however, lie neglected in the bowels of the mountains which contain them, as well as zinc, iron, tin, and other minerals, for which Cyprus was so famous. There are numerous quarries of plaster and marble in the island; and talc is very common, especially near Larnica, where it is employed for white-washing houses. The high mountains contain also emeralds, amethysts, peridots, opals, agates, &c. The Cyprian jasper was esteemed by the ancients as superior to the Egyptian, and is surpassed only by the Scythian; and fragments of very fine red jasper are frequently found in the bed of the river Pedieus, not far from Nicotia. In the rocks is found a beautiful variety of crystallized quartz, called by the natives *Baffa diamond*, because it is procured in the neighbourhood of that city. Amianthus of a very superior quality is also found near the same place. According to Dr Clarke, it is as flexible as silk, and perfectly white; finer and more delicately fibrous than that of Sicily, Corsica, or Norway; and the Cypriots call it the *cotton stone*. It was this mineral which the ancients used for making a kind of incombustible cloth, and the principal manufacture was established in Cyprus, as the materials were

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found here in abundance and perfection. It has been supposed, that the art of making this cloth is unknown to the moderns; but, according to the author already quoted, the inhabitants of a certain district in Siberia are in the practice of preparing thread, by mixing flax with this substance, and then spinning it. After weaving with this thread, the cloth is exposed to the action of fire, which consumes the flax, and leaves an incombustible web. But of all the mineral riches which this island contains, the inhabitants are allowed by their Turkish masters to trade only in yellow ochre, umber, *terre verte*, and salt. This last, when Cyprus was subject to the Venetians, was a very considerable article of exportation, and a great source of revenue, and annually constituted the sole cargoes of seventy large ships. A few country barks, however, are now sufficient for this branch of export trade. The great lake, or salt marsh, where the salt is formed, is in the neighbourhood of Salines, and was formerly three leagues in circumference; but the canals by which the lake communicated with the sea being now much choked up, the water scarcely covers a space of a league in circuit. The evaporation of the water is accelerated by the heat of a burning sun, and there remains a thick crust of salt, which is gathered in the month of September into pyramidical heaps. It then acquires consistence and hardness, and will even resist the winter rains. In the spring it is put on board small vessels, and conveyed to the neighbouring coast.

Animals.

Among the animals of Cyprus, those termed domestic have degenerated like their masters. They have also greatly decreased in number; while snakes, and other hurtful and hideous reptiles, have been allowed to propagate, and to cover the fields. Tarantulæ, with a black and hairy body, and yellow and brilliant eyes, are here not uncommon; and a large spider is sometimes met with, called by Sonnini the *galcode* of the Levant. According to this author, it is about an inch in length, "has a body of a livid yellow, and beset with long hairs, and even with prickly ones in several places. It runs with prodigious swiftness, and thus more easily escapes its destruction, in which mankind are interested, its bite being very dangerous, and its venom very subtle. The parts which are attacked by it swell in an instant, and occasion excessive pain, followed by certain death, if proper remedies be not speedily applied."

Manners and dress of the inhabitants.

The Cypriots are, in general, tall and well made, with an open countenance, and noble and agreeable manners; but they are said to be the most cunning and knavish of all the Greeks. They are, however, remarkable for their hospitality, which they exercise in a most generous manner; and are also very gay, and much attached to show and pleasure. "The women of Cyprus," says Dr Clarke, "are handsomer than those of any other Grecian island. They have a taller and more stately figure; and the features, particularly of the women of Nicotia, are regular and dignified, exhibiting that elevated cast of countenance so universally admired in the works of Grecian artists." They seem, however, to take very great pains to disfigure their natural beauty, by an unbecoming dress, and a profusion of ornaments. The waist is made as long as possible, and the legs consequently short; and though they are naturally corpulent, yet they use no endeavours to diminish the size of their bodies by lacing, but are rather vain of their bulk. The upper robe of the higher classes is always made of crimson, scarlet, or green silk, embroidered with gold; and they wear long scarlet pantaloons, with yellow boots, and slippers of the same colour. Their head dress is a kind of *Calathus*, which is worn by all ranks. Their hair is dyed of a fine brown colour with *henna*, and hangs down behind in long strait braids, with a few ringlets near the face; and from the head, and around the neck, are suspended a profusion of coins, chains, and other trinkets.

Diseases.

The fevers which prevail in this island are almost always malignant, while those experienced in other parts of the Mediterranean are in general intermittent. The inhabitants are consequently obliged to be very careful of their diet; and they consider it fatal to eat flesh of any kind in hot weather, unless it is boiled to a jelly. Fat meat they dare not touch, and they likewise carefully abstain at that season from eggs, cream, milk, and all sorts of pastry.

Manufactures.

The method of grinding corn between two stones, called *querns* in Scotland, is still in use here, and is also common throughout all Palestine. This employment is confined solely to the women; and the operation of grinding is frequently repeated, as they seldom prepare more at a time than what is necessary for present use. The prevalence of this ancient custom shews the rude state in which the inhabitants of these countries are with respect to the arts and refinements of life. Indeed the Cypriots have lost, along with their liberty, both the means and the power of profiting by the progress of civilization in other countries. Their only manufacture worth mentioning, is the preparation of Turkey or Morocco leather. It is carried on chiefly at Nicotia, and in the neighbouring villages; and the workmen pretend that they have a particular method of preparing it, which they keep as a secret. It is certainly both better dressed, and the colour is more durable and more brilliant, than what is made in the other parts of Turkey. They have also a manufacture for printed calicoes, and some other cloths made of silk and cotton. So far back are they in the arts, however, that such stones found in the island as are capable of being polished, must be sent to Grand Cairo for this purpose.

Commerce.

The commerce of Cyprus is now very inconsiderable; and the only place in the island where trade is carried on with any degree of activity is at Larnica. Their principal exports are about three thousand bales of cotton, but of which thirty thousand bales were annually exported by the Venetians; twenty thousand bales of silk of various colours, besides the floss, which is also exported to the ports of Turkey and Europe; the fruit of the careb tree; wine; salt; a considerable quantity of wool; Turkey leather; calicoes; and some cloths. For these, they receive in return woollen cloths, sattins, light stuffs, laces, metals, India spices, colonial produce, &c.

Present state.

Since the conquest of Cyprus by the Turks, its most valuable productions and riches have vanished, and its inhabitants have gradually fallen from the high station which they held when under the Venetians, to the most abject state of apathy and indolence. Every branch of industry and refinement is stamped with a deep impression of Turkish despotism. "The rigours of an oppressive domination," says M. Sonnini, "have shed their baneful influence over fields, arts, and men. Every day we see commerce fail, industry decay, lands dry up, and agriculture become impoverished. Vallies once shaded by useful or agreeable trees, which culture enriched with harvests of every species, or adorned with verdure and flowers, now remain uncultivated, and overrun with brambles, and other stubborn, meagre, and useless plants. One may travel whole days in plains, deserted and abandoned to that mournful and pernicious fecundity, which, on lands impatient to produce, is sterility's constant companion; in factitious wastes, the gloomy and fatal effects of the power of the evil-minded, where the traveller would think himself buried in vast solitudes, did he not here and there perceive straggling flocks and scattered habitations. Every day too, we see population, which increases and settles only where are to be found abundance of provisions, activity of trade and of manufactures, and justice on the part of government, diminish in a perceptible manner; and men quit a desolated country, and, for the most part, seek spots less disturbed, abodes less unhappy." The account which Dr Clarke has given us of the present state of this island, is equally melancholy, and affords an ample lesson of a tyrannical and selfish policy. "Instead of a fertile land," says he, "covered with groves of fruit and fine woods, once rendering it the paradise of the Levant, there is hardly upon earth a more wretched spot than it now exhibits. Few words may forcibly describe it: Agriculture neglected—inhabitants oppressed—population destroyed—pestiferous air—contagion—poverty—indolence—desolation. Its antiquities alone render it worthy of resort; and these, if any person had leisure and opportunity to search for them, would amply repay the trouble. In this pursuit, Cyprus may be considered as yet untrodden."

The frequent emigrations from this island, on account of the oppressive exactions of its rulers, has so reduced its population, that it rarely exceeds sixty thousand persons, a number scarcely sufficient to have peopled one of the ancient towns. The governor is annually appointed by the Capudan Pacha, who generally sells this office to the highest bidder. Every new master is consequently regarded as a tyrant more to be feared than his predecessor, and his short year of dominion is spent in the most unbounded rapacity, in order to recompense himself for the expenditure by which his sovereignty was obtained. See *Herod.* l. iii. iv. v.; *Isidor.* l. xiv.; *Strab.* xiv. xvi.; *Arnob.* l. iv.; *Diod. Sicul.* xi. xii. xv. xvi. xx.; *Plut. in Demet.*; *Just.* xviii. 5; *Ptol.* v. 14; *Flor.* iii. 9; *Plin.* xii. 24. xxxiii. 5. xxxvi. 26; *Mela.* ii. 7; *Ancient Univ. Hist.* vol. iii. p. 772; Rollin's *Ancient Hist.* iii. 197. v. 333. vii. 112. ix. 275. Mariti's *Travels in Cyprus*, &c. vol. i. passim; Sonnini's *Travels in Greece and Turkey*, pp. 24—71; and Clarke's *Travels*, part 2d, page 308, &c. (*p*)

CYRENAIC SECT. See ARISTIPPUS.

CYRILLA. See BOTANY, p. 176 and 250.

CYRTANDRA, a genus of plants of the class Diandria, and order Monogynia. See BOTANY, p. 88.

CYRTANTHUS, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 186.

CYRTOSTYLIS, a genus of plants of the class Gynandria, and order Monandria. See Brown's *Prodromus Plant. Nov. Holl. et Ins. Van Diem.* p. 322, and BOTANY, p. 317.

CYRUS THE GREAT, the founder of the ancient Persian empire, is generally believed to have been the son of Cambyses, king of Persia, and of Mandane, daughter of Astyages, king of the Medes. He was born probably about the year 590 B. C. The biography of this mighty conqueror, however, is inextricably involved in the obscure mazes of contradictory statements and fabulous traditions. The circumstances attending his birth, his education, his expeditions, and his death, may all be regarded as historical problems for the exercise of learning and ingenuity, rather than as authentic facts to be implicitly believed upon the credit of any of the ancient annalists.

According to the recital of Herodotus and Ctesias, Cambyses, in consequence of a dream, ordered the infant Cyrus to be destroyed, and committed the execution of this order to his chief minister, Harpagus. Harpagus, being unwilling to execute this barbarous order himself, gave the infant to the king's shepherd, whose wife happened, at that very time, to be delivered of a dead male child. Being greatly taken with the appearance of the royal infant, she persuaded her husband to preserve him, and expose their own in his stead; and Cyrus was accordingly brought up as their son. Having grown up to manhood, he, after various adventures, dethroned his grandfather Astyages, conquered Crœsus, king of Lydia, overthrew the empire of the Babylonians, published the famous edict by which the captive Jews were permitted to return to Jerusalem and to rebuild the temple; then, pushing his conquests still farther, after a wonderful career of success, created an extensive empire in Asia, which was bounded on the east by the river Indus, on the north by the Caspian and Euxine seas, on the west by the Ægean Sea, and on the south by Ethiopia and the Arabian Gulf. At length, having carried his arms against the Scythians, or Massagetæ, he was defeated and slain in battle by their queen, Tomyris, who caused his head to be cut off and put into a leathern bag full of blood, with these sarcastic expressions—*Now glut thyself with blood, for which thou hast ever thirsted.*

Xenophon relates the history of Cyrus in a manner considerably different. But the *Cyropædia* was evidently written with the view of delineating, for the instruction of sovereigns and of statesmen, the model of a perfect prince, and a well-regulated monarchy; and not with the design of exhibiting a faithful record of historical facts. The narrative of Xenophon, however, has been scrupulously followed by Rollin, and most of the modern compilers of ancient history. There is, indeed, little discrepancy, among ancient authors, in regard to the grand historical features of his reign; the disagreement chiefly respects the birth, education, death, and character of the hero.

According to Xenophon, the education of children was regarded by the ancient Persians as the most important duty, and the most essential part of government. Boys were brought up publicly, in an uniform manner, and accustomed, from their infancy, to gymnastic exercises, and to the utmost temperance in eating and drinking. Cyrus himself was educated in this manner; and, according to Xenophon's account, surpassed all of his age in aptness to learn, and in courage and address in executing whatever he undertook. We cannot afford room to enter minutely into the circumstantial detail of the elegant Grecian biographer. Suffice it to mention, that, after passing through the elementary classes, to the previous discipline of which the Persian youth were subjected, Cyrus was, at length, initiated into the actual business of war; being intrusted with the command of the troops which were sent to co-operate with the forces of his uncle Cyaxares, who had succeeded Astyages on the throne of Media, and was involved in a contest against the Babylonians. In all his campaigns, Cyrus displayed uncommon address and military genius; and was no less renowned for the generous and benevolent virtues, than for courage, prudence, and warlike abilities in the field. We have already observed, that, in regard to the principal historical events of his reign, there is not any very material difference between the narrative of Xenophon and those of other ancient authors. These events will be related hereafter, in the article PERSIA. But, according to Xenophon's account, Cyrus, instead of falling in battle, died quietly in his bed, after a long and prosperous reign, full of years and of glory. Plutarch relates, in the life of Alexander the Great, that the Macedonian conqueror, when in Persia, having found the tomb of Cyrus broken open, discovered the following epitaph, in the Persian language. *O man! whosoever thou art, and whencesoever thou comest (for come I know thou wilt), I am Cyrus, the founder of the Persian empire. Envy me not the little earth that covers my body.*

It is not an easy task, at this extreme distance of time, to reconcile these contradictory statements of the ancient historians, or to separate what is true from what is false or fabulous in their various narratives. But to us, Cyrus appears to have been one of those able and enterprising men, who have frequently appeared on the theatre of Asiatic history; who, possessing talents far superior to those of any other man of his age and nation, had the address to unite the whole of the different Persian tribes under his own dominion; as, in a later age, Gengis-Khan contrived to get himself placed at the head of the Mogul hordes. The time of his appearance was fortunate; the empire of the Medes and Babylonians was already upon the decline; and that of the Lydians, under Crœsus, had not yet acquired a solid foundation. That Cyrus, as a prince and a statesman, possessed great and good qualities sufficient to entitle him to much of the praise which has been lavished upon him, there seems little reason to doubt; that he was deeply infected with the common vice of all great conquerors, an insatiable ambition, is evident enough from the history of his eventful career. That Xenophon purposely magnified the virtues, and embellished the exploits of this powerful conqueror, appears to be generally admitted; and his object in doing so has been already explained. But, at the present day, it were difficult to point out what portion of the traditionary character of Cyrus is with justice ascribed to him, and what portion is to be imputed to the lively fancy and inventive genius of his biographer. See *Rollin*, B. iv. ch. 1.; Millot, *Hist. Ancienne*, tom. i.; *Memoires de l'Acad. des Inscript.* tom. vi. & vii.; and Bayle, *Dict. Hist. et Crit.* v. CYRUS. (*z*)

CYTHERA. See CERIGO.

CYSTANTHE, a genus of plants of the class Pentandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl.* &c. p. 555; and BOTANY, p. 177.

CYTINUS, a genus of plants of the class Monœcia, and order Monadelphia. See BOTANY, p. 327.

CYTISUS, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 284.

CZAR, or TSAR. See RUSSIA.

CZARSKOSELO, or TSARSKOSELO, the summer residence of the Russian sovereigns, is about 22 versts from St Petersburg, between that city and Novogorod. The palace is built of brick, and has a front which extends nearly eight hundred feet. It is all plastered over, and is covered with columns, pilasters, and cariatides, all of which are gilt. The rooms are gaudy and spacious, and the walls of one of them are entirely covered with pictures, by the best of the Flemish and other masters. They are all fitted together, without frames, and without any arrangement; and it is said, that the vacant spaces were filled up with pictures cut down to suit the spaces that were left. The most interesting apartment in this palace is a room about 30 feet square, which is covered on all sides with amber, which was a present from the King of Prussia. In the apartment fitted up for Prince Potemkin, the floor was covered with different kinds of exotic wood, interlaid; and it is said to have cost an hundred roubles for every square archon.

The ball-room is an hundred and forty feet long, and fifty-two feet wide; and is two stories high. In another apartment, the walls, pilasters, and tables, were adorned with *lapis lazuli.* The cabinet of mirrors is a small room, lined with large pier glasses, and looks into a terrace, where there is a covered gallery, above two hundred and sixty feet long. The chapel is made wholly of gilt wood, and is richly decorated.

The gardens are laid out in the English style, and contain many statues in marble and bronze. A small flower garden conducts to the bath, which is adorned with agates, jasper, and marble statues and columns. The grotto is likewise ornamented with various minerals, formed into columns, vases, busts, and bas-reliefs, the most interesting of which is a vase, composed of precious stones, from Siberia. The rostral column, erected to Orlof, in memory of the naval victory gained at Tchesmé, over the Turks, is seen from this grotto, upon a lake. Among several bridges, Mr Coxe was particularly struck with one, built after the model of the Palladian bridge at Wilton, the seat of Lord Pembroke. It is of the same size, but of superior magnificence, the colonnade being of marble, and the lower part of granite. The marble was wrought in Siberia, by an Italian artist, who took nine years to finish it. There is a large court before the palace, encircled with low buildings, for the kitchens and out-houses.

On the road from St Petersburg, the versts or distances are marked by columns of marble, jasper, and granite; and when the court is at Czarskoselo, there are 1100 globular lamps lighted. This palace was built by Catherine I. but received its principal embellishments from the Empress Elizabeth. It was the principal residence of Catherine the Great, during the latter part of her life. See Storch's *Picture of St Petersburg*; Reinbeck's *Travels from St Petersburg in 1805*, Letter xi.; Coxe's *Travels in Holland, Russia, &c.* vol. ii. p. 199, 200; but principally Clarke's *Travels*, vol. i. p. 16—21. (*j*)

D.

Daca || Daghestan.

DACA, or DACCA, a town of Hindostan, in the eastern part of Bengal, is situated upon the eastern branch of the Ganges, about 100 miles from its embouchure, and is the capital of a province of the same name. As the Daca river communicates with the other inland navigations, and as the country is very fertile, this place has long been the emporium of a great inland commerce. It is reckoned one of the most disagreeable towns in India, being composed of a prodigious number of thatched houses built with mud, with a few brick houses in the Moorish style scattered up and down. Daca is famous for the great trade which it carries on in muslin and cotton cloths, and at one time it supplied the coasts of Delhi and Moxudabat, by means of agents resident in the town. Daca is reckoned the third city of Bengal in extent and population; and it was once the capital of Bengal. The remains of a strong fortress are still to be seen. (*w*)

DACTYLIS, a genus of plants of the class Triandria, and order Digynia. See BOTANY, p. 103.

DÆMIA, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 179.

DÆMONIACS. See DEMONIACS.

DAGELET, the name of an island in the sea of Japan, situated at the distance of 20 leagues from the coast of Corea. It was discovered by the astronomer whose name it bears, and who accompanied the unfortunate La Perouse. Excepting at seven small sandy creeks, at each of which there is a landing-place, the island is encircled with a perpendicular wall of rock. The circumference of it is about 9 miles, and the whole of its surface is covered with the finest trees, which, it is probable, the shipwrights of the Corea use for building vessels. La Perouse saw on the stocks several boats of the Chinese form. There were a few huts in the island, but no appearance of cultivation. Krusenstern, in his late voyage, passed to the east of this island. East longitude, according to solar observations, 130° 57′ 22″, North latitude 37° 22′ 18″. See La Perouse's *Voyage*. (*j*)

DAGHESTAN, or DAGESTAN, or DAUGHESTAN, is a province of the kingdom of Persia, stretching along the west coast of the Caspian Sea, and lying on the southern side of the highest ridge of Mount Caucasus. It is bounded by the province of Schirvan on the south, the Caspian Sea on the east, the province of Kumuk on the north, and Georgia on the west. As the name Daghestan implies, the province is almost wholly mountainous, the plain having a considerable breadth only towards Kumuk.

The districts which compose this province are five, Lesgestan, Schamgol, Uzmey, the khanship of Derbund, and the domain of Tabasseran. The district of Lesgestan, which consists chiefly of a range of lofty mountains, extends in a south-easterly direction, and forms the whole of the north-east boundary of Georgia. This district, which is very long and narrow, is inhabited by the Lesgi, or Lesghaes, a savage race, divided into different tribes. Their houses are perched upon the tops of the mountains, and on the most tremendous precipices. Ravines, and gulfs of unmeasurable depths, are joined by stone or wooden bridges of the greatest strength; and the most precipitous rocks are crossed by roads. Spring water is conducted every where by pipes, or by canals excavated from the solid rock, and the course of streams is turned to answer their purposes. From the poverty of the soil, and the small quantity of level ground in the district, the inhabitants form artificial terraces on the sides of the mountains, and thus raise crops on the most barren and inaccessible rocks. The Lesgaes are the scourge of the surrounding countries, whose villages they lay waste, carrying off the inhabitants as slaves. They are chiefly Mahomedans, and those who have not yet embraced the faith are sunk in the grossest idolatry. In consequence of their great bravery, the Lesgaes are hired to fight for their neighbours at the rate of 12 roubles a campaign, which lasts only three months; and it often happens, that they fall by the hand of their own brothers or relations. They dress after the Tartar fashion, and their arms are a gun, pistol, dagger, and sabre. The Lesgae women excel in beauty and symmetry all the other females of Mount Caucasus, and bring the highest prices in the market of Constantinople.

Daghestan.

The district of Schamgol, Schamchol, or Schabaal, which lies in the northern part of Daghestan, is about 100 versts long, and 55 broad. The plain is cultivated, and produces corn, being well-watered by the rivers that descend from the mountains. The houses of the inhabitants are situated on the mountains, and the sheds for their cattle are erected on the plain. The capital of the district is Tarki, which is situated in north latitude 42° 50′ on the Caspian Sea, in a narrow glen, through which runs a number of streams of salt water. It is said to contain 10,000 inhabitants, among whom are many Armenian and Georgian merchants. The town of Buinaki, or Boinak, situated in the same district, stands on a rivulet of the same name, at its exit from the mountains. The district of Uzmey is situated between two small rivers, the Urusai Bulak and the Little Darbach, and extends about 60 versts along the Caspian, and about the same distance in breadth. It is chiefly mountainous, but is well inhabited, and produces abundance of wood and corn. It is watered by three large rivers, the Chamraseni, the Great Buam, and the Great Darbach, which are divided into small canals for the purposes of navigation. The residence of the Uzmey is at Bashli, a small town upon a river of the same name, between Tarki and Derbund.

The khanship of Derbund, or Derbent, is only about 30 versts long, and 12 broad. It lies between the rivers Darbach and the Rubas, and forms a broad and partly marshy level, intersected by numerous rivulets, and adorned with many beautiful and well cultivated corn fields. Derbund, the capital of this district and of the whole province, occupies the site of the ancient Albania, and stands in north latitude 41° 52′. It is encircled with a wall and towers, and has a citadel erected on the top of a rock, but at too great a distance either to defend the town or the harbour. A portion of the famous wall of Gog and Magog, which is said to have reached to the Black Sea, is still to be seen near the citadel. It stretches to the west over precipitous mountains, and is extremely solid. The splendid aqueducts erected by the Arabians being now in ruins, water is procured very scantily from wells. Derbund

Dago
||
Dahomy.

was taken by the Arabians, and called by them Babe-ul-islam, (the gate of faith); but since 1796, it has been in the possession of the Russians. It contains about 647 houses, and its principal inhabitants are Armenians, Mahomedans, Jews, and Russians.

The district of Tabasseran is about 50 versts in extent, and reaches to the highest of the Lesghaen mountains. It lies between the Darbach and Rubas near their sources, and consequently to the west of Uzmey. The vallies are beautiful and fertile. The inhabitants speak a language of their own. According to Reinneg, they amount to 10,000, and the family of the reigning prince has held the supreme power for 600 years. The town of Tabasseran is the centre of the trade carried on between Russia and Daghestan. See Reinneg's *Historical and Topographical Description of Caucasus*, and Macdonald Kinneir's *Geographical Memoir of the Persian Empire*, p. 353—356. (π)

DAGO, or DAJEN, or DAGHO, the name of an island in Riga, belonging to Russia. It is about 34 miles long, and 24 broad. The southern and the eastern parts of the island have a good soil, consisting of a blueish clay, and produce a considerable quantity of corn. The western part of the island is very sandy. There are forests and abundance of stone in the island. The population is so great, that the estates are overburthened with vassals, many of whom go to the mainland, and employ themselves in embanking, bricklaying, &c. and it is said that whole families are frequently sold. The inhabitants are principally Esthonians, and there are whole villages inhabited by Swedish Boors. The principal places in the island are Rekki, Pegalep, Paden, and Dager-ort. The position of the lighthouse of Dager-ort, situated on a hill 130 feet high at the western point of the island, has been ascertained by astronomical observations. It lies in east longitude 22° 9′ 15″, and north latitude 58° 56′ 1″. (π)

DAHALAC. See DHALAC.

DAHLIA, a genus of plants of the class Diœcia, and order Monandria. See BOTANY, p. 353.

DAHOMY, a kingdom of Africa, often called by the inhabitants FOY, is situated on the northern side of Guinea, of which it forms a part, and extends 150 or 200 miles inland. The boundaries of the kingdom have not been exactly ascertained by travellers, but its capital Abomy lies in about 9° 50′ N. Lat. and between 3° and 4° E. Long. Of the inland kingdoms, that to the west is called Mahee, and that to the north-east Eyeo. Till the beginning of the 18th century the Dahomans were an inconsiderable nation, known by the name of Foys; and the town Dawhee, which lies betwixt Calmina and Abomey, about 90 miles from the sea-coast, was the capital of their small territory. But by conquering and annexing to their dominions the kingdoms of Whydah, Ardrah, and Jacquin, and thus extending their boundaries to the sea coast, the country became better known to modern geographers; and the English, French, and Portuguese, erected and maintained forts in it for the protection of the slave trade. As these countries now form a part of the Dahoman kingdom, they will be included in our description of it.

History.

The present name Dahomy, is said to have been derived from the following fact in the history of the country. In the beginning of the 17th century, Tacoodonou, chief of the Foy nation, basely murdered a neighbouring prince who had paid him a friendly visit. He then attacked and took Calmina, the capital of the deceased. Strengthened by that acquisition, he declared war against Da, the king of Abomey, who soon fell into his hands; put Da to death by cutting open his belly, and placed his body under the foundation of a palace, which he built in Abomy, and which he called *Dahomy;* from *Da,* the unfortunate victim, and *homy,* a belly; that is, a house built on Da's belly. After that conquest, he fixed his residence at Abomy, and assumed the title of king of Dahomy; his ancient subjects still retain in that country the name of the *Foys,* but to Europeans they are known by the name of Dahomans.

Dahomy.

In this manner Tacoodonou conquered Abomey, and founded the Dahoman empire, about the year 1625. He was succeeded by Adaunzou I. in 1650, and by Vibagee in 1680; but little of the history of the country is known till Trudo enlarged the boundaries of the kindom, by adding to it by conquest the kingdoms of Ardrah, Whydah, and Jacquin, betwixt the years 1708 and 1727. This people, like the other Africans, have no other records of history than the traditionary legends of their bards; and their kings forbid any transactions to be mentioned which might reflect disgrace upon them or their ministers. The character of Trudo is very differently drawn. By some he is represented as extremely cruel to those who opposed his arms, but mild and generous to the vanquished; remarkable for his kindness to Europeans, and exhibiting many traits of a great and generous mind. By others it is affirmed, that his policy was that of an ambitious and brutal savage, who sought to retain the territories he had gained by the horrid cruelty of burning the towns and butchering the inhabitants; and that his reign entailed lasting calamities on his country. He died in 1732, and was succeeded by his son Rossa Ahadee, who is described as tall in his person, graceful in his manners, polite to strangers, but the terror and scourge of his own subjects. During a reign of upwards of 40 years, his country was wasted by wars foreign and domestic; and the mind is filled with horror at the recital of the many sacrifices of human victims, for the purpose of *watering* (according to the expression of that country) the graves of the deceased royal family. In 1774, he was succeeded by Adaunzou II. by whose authority these, and similar barbarous customs, of which we shall take some notice, still continued to be sanctioned.

Soil and productions.

The country lying behind Whydah, rises with a gentle and gradual ascent for about 150 miles from the sea, before there is any appearance of a hill or mountain; and to the extent of 400 miles into the interior it is covered with verdure, with open plains of grass, and some woods and forests. The surface is generally a loose sandy soil; below that is a reddish earth; and what is very remarkable, there is not a stone to be found in it of the size of a walnut. The villages are pretty large and numerous. The houses are constructed of mud walls, and covered with straw; and are generally built at such a distance from each other, as to admit betwixt them patches of cultivated ground.

Of fruits and vegetables, the country yields a plentiful supply, in proportion to the care bestowed on their cultivation. Pine apples, melons, oranges, limes, guavas, and other tropical fruits, are to be found here in great variety. The soil also produces abundance of maize, millet or Guinea corn, pease, and beans. They likewise cultivate yams and potatoes, the plantain, the banana, and the cassada or *manioka;* which, in tropical climates, is the cheapest of all the substitutes for bread. A fruit of a very remarkable quality is produced in this country, as well as in some other parts of Africa. In size and shape it resembles a

Dahomy.

Soil and productions.

small olive, and is of a dusky-reddish colour. The pulp is firm, and almost insipid; the stone hard like that of the olive. After chewing the fruit, a glass of vinegar tastes like sweet wine, a lime has the flavour of a ripe orange; and the same change is produced upon other acids, the berry having the surprising quality of converting acids into sweets. Like the other inhabitants of tropical climates, the Dahomans plant twice a-year, viz. at the vernal and autumnal equinoxes, after which the periodical rains set in. They may, indeed, be said to reap four, or rather two double crops; for soon after the maize appears above ground, they plant *callavanas* betwixt the rows, which gives the fields a very beautiful appearance. Whydah is a very fertile country, but to Europeans the heat of the sun is almost insupportable.

Nor is the country destitute of various productions adapted to commerce and manufacture. Of these, the following may be accounted the chief: the *indigo* plant, which is very common, but the natives cannot prepare it for market: *tobacco*, which in several places grows spontaneously, but also requires the hand of a European to prepare it for use: *cotton*, which the natives manufacture into cloth for their own use: *pepper*, of the same species, and scarcely inferior in flavour to that of the East Indies: the small *berry* just mentioned, which serves as a substitute for sugar: *palm oil*, a very valuable production, which is exported in large quantities for the use of the British wool-combers and soap-boilers; when mixed with potash, it is manufactured into a very good soap: and *peltry*, such as tiger and leopard skins, &c. but which are not of great value. Besides these, there is an infinite variety of other valuable productions scattered over the country by the liberal hand of nature; but the natives are indifferent to the blessings that surround them.

Character and manners.

Like other Africans, indolence is the most prominent feature of their character. The men sleep and smoke, enjoying in thoughtless security the present moment, and regardless of the future; while the whole labour of agriculture devolves upon the women. Indeed, the general torpidity of this people justifies a common remark, that in Africa, in proportion as the soil is fruitful, the inhabitants are averse to industry. They are warlike, keep a secret inviolable, are much addicted to plunder, and even make a merit of robbing the white people. The Negro is very hospitable to other Negroes; is in general sober, and goes to excess only in drinking brandy; but he is vindictive, lying, and obstinate; and yet he cannot be denied the character of gentleness. They are very cleanly in their persons, and particularly so with regard to their food. Their bread is made of maize or millet, sometimes baked, and sometimes boiled into a thick pudding; and their chief dish is a soup, composed either of flesh or fish, with a variety of vegetables, enriched with palm oil, and well seasoned with pepper and salt.

Dress.

The dress of the Dahomans is light, and suited to the climate. That of the men consists of a pair of striped or white cotton drawers of the manufacture of the country, over which they wear a large square cloth of the same, or of European manufacture. The head is covered with a beaver or felt hat; the arms and upper part of the body are naked, except when travelling or performing any work; then the large cloth is thrown off, and the body covered wich a frock without sleeves. The feet are always bare, for none but the sovereign is permitted to wear sandals. In the hand is usually carried either a cutlass or a wooden club; and every person is provided with a tobacco pouch, which contains also a flint, steel, and tinder. In war they paint their faces and bodies, which gives them a most terrific appearance. The women wrap cloths and handkerchiefs round their bodies; their necks, arms, and ancles are adorned with beads and cowries, and their fingers with rings of silver or other metal. Both sexes are less addicted to the practice of cutting or *tattowing* the body than their neighbours; they make only a perpendicular incision, which leaves a mark between the eye-brows. In Whydah, they cut their foreheads and cheeks in such a manner, as to give them the appearance of being much pitted with the small-pox; and the women mark the lower part of the body with various devices.

Marriage.

When a young man wishes to marry, he makes his proposal to the young woman's father, who consults his daughter. If she consents, the marriage contract is concluded, and the bridegroom makes a present to his father-in-law of cowries and brandy. When the young woman is marriageable, the husband is informed, who, as soon as the marriage is consummated, makes a present to the bride, and another to her father. The men may divorce their wives; and the women have an equal liberty of withdrawing themselves, without any formality, and of taking another husband. In such a state of degradation are the women held, that they must bend the knee when they present any thing to their husbands, rise up only with their permission, and never eat along with them, nor in their presence. As polygamy is sanctioned both by custom and law, a man may marry as many wives as he pleases; adultery, however, is punished with death; and, indeed, every instance of gallantry, in the married state, exposes the delinquent to death or slavery. But what tends more than any thing to eradicate all the parental aud filial affections, is a principle of the state, that parents have no property in their children. They are considered as belonging entirely to the king, and are taken from their mothers at an early age, and dispersed among the villages remote from the places of their nativity, where they remain subject to the king's future destination of them, and with little prospect of ever being again seen or recognised by their parents. This arises from the king's jealousy of family connections, which might lead to associations dangerous to his unlimited power. The consequence is the almost total extinction of parental affection and filial love. Parents, instead of cherishing, endeavour to suppress those tender attachments to their offspring, which they know will be violated as soon as their children reach the age at which they can be taken from them.

Manufactures.

From the shells of the *calebash* fruit they form, in a rude manner, their domestic utensils; and, with the implements of a forge very simply constructed, they contrive to fabricate not only the necessary implements of husbandry, but also carpenters tools, cutlasses, spears, and other warlike weapons. The anvil is of stone, or an old iron cannon; and the hammer is a thick piece of rounded iron, which they hold by one end. Besides blacksmiths, they have also braziers and silversmiths, who make bracelets, rings, and various trinkets of brass or silver. They make also earthern pots, water jars, and other utensils of the same materials. Nay, with looms of a very rude construction, they manufacture neat and durable cotton cloths, which are not only very valuable among themselves, but are also purchased by Europeans at a high price. Their dyes, especially their blues, are very durable. They make very neat

Dahomy. mats, and also weave cloths of the palm-tree leaves, which they sometimes dye, but more frequently wear in the natural colour, which resembles that of nankeen.

Animals. The country abounds with deer, sheep, and goats, (whose flesh is said to be equal to mutton,) hogs both wild and domestic; a variety of poultry, particularly the Guinea hens and Muscovy ducks; and the lakes are stored with mullets, carp, and other fish. The agouti, (called by the British traders *bush-cat*,) a gregarious animal, abounds in this part of Africa, and its flesh is accounted very delicate by the natives. It is about the size of a full grown hare, but rather thicker; and when divested of its skin, the body appears incased with fat. Like the hare, the hinder legs are longer than the fore legs, but the ears are short and rounded; the mouth is shaped like that of a rat; and the feet are small. The body is covered with stiff bristles, which it has the power of erecting, but which adheres so slightly to the skin as to be easily separated. They generally go in companies of fifteen or twenty in number, following one another in the same path, and their bite is very severe; but the natives, by attacking the rear of the party with sticks, are able to destroy two or three at a time. Their flesh is very fat, and tastes greasy and strong, unless when dried and smoked; a preparation which makes it exceedingly palatable. The markets are well supplied with provisions at reasonable prices, beef excepted, which is scarce in the country. On the coast of Whydah, a turtle of 100 pounds weight has been purchased for a single flask of brandy; and, indeed, a ship's company may be furnished there with fresh provisions at a cheaper rate, and in greater abundance, than on any other part of the coast. The elephant, though his flesh be coarse, is used for food by the natives; and dogs are fed for the same purpose.

Language. Their language is what the Portuguese call *lingua-geral*, or general tongue, and is spoken, not only in Dahomy *proper*, but also in Whydah and the other dependant states.

Religion. Their religion, like that of the neighbouring kingdoms, consists of such a mass of superstition as can hardly be described. The objects of their devotion are the sun and moon, various animals and trees, and other substances. The Portuguese word *fetiço*, or, as the English pronounce it, *fetish*, signifying witchcraft, has been adopted by most of the maritime natives of Africa, as well as by the Europeans who trade thither. Of their *amulets*, or *charms*, the principal is a scrape or parchment, containing a sentence of the Koran, which the natives purchase from the Moors who visit the country, and which they hang up in their apartments, and decorate with a variety of rude images. Among the objects of their idolatrous worship, is a species of snake or serpent called *Daboa*. It is quite harmless, and suffers itself to be handled, without appearing irritated; but there is another species which resembles it, and is very dangerous. When they meet the serpent *Daboa*, they put it into a basket, and place it in the temple destined for it, where they secretly feed it with rats, but pretend that it lives upon air. The temple is served by priestesses, supported at the king's expence. Every year there is a festival in honour of this serpent, at which the grandees assist, and for which the king supplies the necessary articles. It lasts usually seven days, during which time the people abandon themselves to drinking, music, and dancing. Great faith is placed in the serpent. Those who labour under bodily pains, apply the animal to the part affected; and pregnant women offer prayers to it for a favourable delivery. The tyger is also held in veneration; and there is a temple dedicated to the Devil, or bad Dæmon. Notwithstanding these superstitions, the people have a confused idea of a Supreme Being, all-powerful and infinite, whom they endeavour to propitiate by their *fetish*; but pay him no other worship, as they are convinced that he is too good to do them any evil.

Government. The government of Dahomy is the most complete despotism that can be found on the face of the earth. All ranks are in the lowest degree of subordination to the king; and all acknowledge his right to dispose of their persons and property at pleasure. On his entrance at the palace-gate, the highest officer of state crawls on his hands and knees till he arrives in the royal presence, where he prostrates himself, rubbing his head in the dust, and uttering the most humiliating expressions. In the same abject posture he communicates his business, and receives the commands of his sovereign. Nevertheless, he receives strangers with courtesy. Ambassadors from foreign courts are permitted to salute the sovereign, according to the mode practised in their own country; European governors and masters of ships, are allowed to sit covered in his presence; and, as a peculiar mark of royal favour, he has been known to shake hands with a European. The reverence paid to him by his subjects, is a compound of love and fear, approaching to adoration. When Mr Norris asked a soldier, who was just going to battle, if he was not afraid of finding the enemy too strong, "I think of my king," said he, "and then I dare engage five of the enemy myself. My head belongs to the king, not to myself. If he pleases to send for it, I am ready to resign it; or if it is shot through in battle, it makes no difference to me; I am satisfied if I lose it by the order of my king." As the king is thus master of the lives, so is he also of the properties of his subjects. When a man is accused of a crime, he is condemned to slavery or death; his effects are then forfeited to the king; and his domestics, relations, and friends, are all seized, and either put to death, or sold for slaves; yet, whatever the king does, they are persuaded is right. A more abject submission, and a more despotic authority, are nowhere to be found.

Officers of state. The officers of state are, first, the prime minister, who is called *tamegah*, who ranks next to the king, aids him in the cares of government, and is the *only* person in his dominions whose head he cannot take off at pleasure. The next in rank is styled *mayhou*, another counsellor; is master of ceremonies; directs the public festivals; and has the care of all strangers. Upon the king's decease, these two officers have the power of setting aside the eldest son, and of nominating any of the other sons of the royal family whom they deem more worthy of the crown. They are also the judges in all criminal cases, and are constantly with the king, to inform him of every thing that passes in the kingdom. The commander of the army, which amounts to about 8000 men, is next in rank, and is styled *agaow*. And the last is the master of the horse, *jahou*, whose office is to take charge of the criminals, and see that their punishments be inflicted; to superintend the agriculture of the country; and supply the king's household with provisions.

Division into classes. The nation is divided into three classes; the merchants, the military, and the manufacturers. The merchants are the first in rank. The military, with the exception of the officers, who have a regular pay, are paid only when on duty. The soldier, in the time of peace, is employed in cultivating the ground, and in fabricating every thing he needs. Every one pays taxes, either in kind, or by composition. There are very heavy duties on every article of commerce, which are collected with great strictness by commissaries or officers stationed in every quarter of the country.

Barbarous ceremonies at the king's death.

The moment the king expires, a horrid scene commences in the palace. The wives of the deceased begin with breaking and destroying the furniture, and every thing of value that belonged either to themselves or to the late king. This destruction continues till the *tamegau* and *mahou* have announced the successor to the crown, and he has taken possession of the palace, which he does with all expedition, and that instant the desolation ceases. This barbarous custom may have originated in a laudable desire, either to accelerate the choice of a successor, in order to prevent a civil war, or to confirm the attachment of the people to a monarchical form of government, by disgusting them with the turbulence and licentiousness incident to democracy; or it may be no more than would happen in any country, where slaves are for a time released from the awe of a despotic power.

As soon as the decease of the king is made public, eight men dig a ditch, about 12 feet deep, and 7 long; then they erect a kind of couch, adorned with every thing that the deceased reckoned most valuable, which they place upon a stage enveloped with all kinds of cloths. Upon that stage they cause the eight men who have dug the grave to ascend, when their heads are instantly struck off, and their bodies thrown into the fields for food to the wolves and the birds of prey. Then appear a crowd of the king's women contending for the honour of being shut up in the tomb, to serve their late sovereign; 24 of these are selected, to the great grief and lamentation of the rest. To confirm these unhappy victims in their error, care is taken to put into the grave or tomb of the deceased king, a great variety of articles of food; and they are strictly charged to take great care of him, to sprinkle him with perfumes, to cover him with aromatic herbs, to give him drink and materials for smoking, and to burn incense every day about the body. They then contend for the honour of descending first into the tomb, which is afterwards shut, and covered with earth; and for five days guns are fired. After a certain time, they celebrate the great ceremony of the funeral, to which all the chiefs of the European factories, of the tributary princes, and of the governors of provinces, must repair, carrying with them a variety of presents. The whole concludes with the sacrifices of particular beasts, and birds, and human beings, to the manes of the deceased king; and their carcases are thrown into the fields, as food to the wild beasts.

A grand festival, which continues some weeks, is called the *annual customs*, at which the viceroy of Whydah, the governors of the forts, towns, and provinces, the Black merchants and traders, must attend with their presents, which consist of pieces of Indian damask, or other valuable silks; and, indeed, every head of a family must attend for a few days, and bring a quantity of cowries (the current money of the country), or some other present, proportioned to his circumstances. A particular account of this festival would not afford much amusement to our readers. It continues about a month, during which there is some public exhibition every fourth or market-day; the intermediate days being employed in preparations. One day is set apart for singing and dancing; and the performers are rewarded according to their merit. Another is allotted for feasting in the market-place, where tents are pitched for the king and his attendants, for the White visitors, and ambassadors from foreign states. The bards rehearse the whole history of their country, which continues for several days. The young men, prostrating themselves in the dust, beg to be favoured with wives. The females are handed out of the palace, and distributed among the petitioners; each must take the one assigned to him, and the cowries are received in return. The king informs himself particularly of the behaviour of his slaves; and, upon this occasion, the meanest have access to him, and have an opportunity of applying personally for redress. Various scenes are exhibited during this festival, which concludes with the erection of a large stage near the palace, on which are piled heaps of silesias, checks, calicoes, cotton cloths, a variety of other European and Indian goods, and a prodigious quantity of cowries. When all is ready, the king ascends the stage with his officers, and other persons of rank; and the whole of the goods are then thrown over the stage, among the surrounding multitude, for which a violent scramble ensues, to the great entertainment of all present. The whole festival itself would afford an amusing spectacle, were it not for the human sacrifices with which it is accompanied, for the purpose of *watering*, according to the country expression, the graves of the deceased royal family.

The Harmattan.

This country is frequently visited by the ***Harmattan*** wind, which indeed extends along this part of the coast of Africa, from Cape Verd at least as far south as Cape Lopez. It prevails in the months of December, January, and February, blowing from the north east; and continues one or two, sometimes five or six days at a time: it has even been known to last a whole fortnight, and there are generally three or four returns of it every season. It is always accompanied with an unusual gloominess and haziness of the atmosphere: the sun can be seen only for a few hours at noon, and assumes a red colour, which excites no painful sensation in the eye. In proportion to the distance from the sea-coast, the fog decreases; and, at four or five leagues from it, is scarcely discernible, but the wind is felt ten or twelve leagues inland. It blows with a moderate force; and, during its continuance, not the least appearance of moisture in the atmosphere is ever perceived. Salt of tartar dissolved in water, and exposed to the Harmattan, even in the night, becomes perfectly dry in a few hours. Vegetables of every kind suffer from it. The grass withers, and dries like hay; all tender plants are killed by it; the most flourishing evergreens feel its baneful influence; the branches of the trees droop, and the leaves become flaccid; and the fruits, robbed of their usual nourishment, are cramped in their growth, and become perfectly dry before they have arrived at half their usual size. In short, when it continues for some days, vegetation is completely checked, and every production of nature fades and withers. Nay, such is its penetrating quality, and so extremely dry is the atmosphere during its continuance, that the covers of books, shut up closely in a trunk, and protected by lying among clothes, have been found bent back, as if they had been exposed to a fire; the pannels of doors and window-shutters split; the sides and decks of ships become quite open and leaky; and casks containing liquor, if not frequently wetted all over, generally lose their contents. Nor are its effects on the human body less severe. The eyes, nostrils, lips, and palate, become dry and uneasy; and the mouth requires to be frequently moistened; the

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lips and nose become chopped and sore; and though the air is cool, there is a disagreeable sensation of prickling heat upon the skin, as if it had been washed with spirits of hartshorn. If this wind continues for five or six days, the scarf skin peels off from the hands and face, and even from the rest of the body, if it continues a few days longer.

Such are the baneful effects of the Harmattan on animal and vegetable nature, and yet it is not unproductive of beneficial effects on the human system. In certain diseases it is conducive to health. It contributes to the cure of ulcers and cutaneous eruptions; of fluxes, and intermitting fevers; and, in all cases in which the frame has been relaxed, the nerves soon resume their former tone and vigour. Infection not being easily communicated in that dry state of the atmosphere, the Harmattan stops the progress of all epidemic diseases; and the small-pox, fluxes, and remittent fevers, not only disappear, but those who are labouring under these disorders, are blessed with a speedy and perfect recovery. See Dalzel's *History of Dahomy*; Norris's *Memoirs of the Reign of Bossa Ahadee*; and *Voyage à la Cote de Guinée*, par Labarthe. (A. F.)

DAIRY, a place where milk is deposited, and where it is manufactured into butter, cheese, and other articles of food. In some situations, the farmer brings his milk to market in its natural state, and then he is said to keep a milk dairy; in other situations he manufactures butter or cheese, and, in such cases, he is said to keep a butter or a cheese dairy. It is quite evident, that it must depend on circumstances, which of all these three sorts will afford the most profit. Within a few miles of a large town, where there is always a ready sale for milk and butter, and where the carriage is short, the milk and butter dairy will generally answer best; but where the distance from a market is considerable, the sale of milk in its natural state is out of the question, and the dairy farmer will probably find it necessary to engage in the manufacture of cheese.

Sir John Sinclair, in his *Account of the Systems of Husbandry adopted in the more improved Districts of Scotland*, states, that in the neighbourhood of Glasgow and Paisley, such farmers as live within two miles of these towns, sell their milk there when newly taken from the cow. Those who are from two and even to ten miles distant from town, generally churn their whole milk, and sell it and the butter in Glasgow or Paisley; and all who live at a greater distance make their milk into cheese. "The produce of these different modes," he says, "is in the proportion of 6d. per Scotch pint (that is two English quarts) for new milk, 4d. when churned, and sold in butter and butter milk, and 3d. when made into cheese." The nourishment derived from a pint of milk used fresh, is equal to that of two when made into cheese, together with the meat that is obtained from the whey when employed in feeding hogs. The dairy system is perhaps the most profitable, as well as the most pleasing, of all the parts of husbandry. It was certainly the earliest. Herbage may be converted into human food, either in the form of flesh or of milk; but it is calculated, that a much larger quantity of human food will be produced from the same quantity of herbage in the latter case than in the former. The herbage that would be sufficient to add 112 pounds to the weight of an ox, would, if employed in feeding cows, afford 450 English gallons of milk. This, if made into cheese, which is not the most advantageous way of consuming milk, would produce 430 lbs. besides the flesh that might be obtained by feeding hogs with the whey. The 112lbs. of beef, at the rate of 8s. a stone of 14lbs. would amount to L. 3, 4s.; but the 430lbs. of cheese at 12s. a stone of 24lbs. would bring more than L. 10, 10s. The trouble and expence, however, requisite to produce the cheese, would be greater than what would attend the production of the beef.

Buildings for the purposes of the dairy.

In the erection of such buildings as are necessary for dairy purposes, two things ought always to be kept carefully in view,—conveniency of situation, and the preservation of a proper temperature. If the buildings are inconveniently situated, much labour will be lost; and if the air in them be either too hot or too cold, no process will go on as it should do. Their size will be proportioned to the number of cows kept, and their interior arrangement to the business intended to be carried on, whether this be cheese-making, butter-making, or merely the preservation of milk for sale. A dairy-house for forty cows, may be twenty feet by sixteen; and for an hundred cows, forty feet by thirty. These are the usual proportions in the county of Gloucester. Ornament is sometimes studied in the erection of a dairy-house; and this, when it happens to be the case, will of course regulate in a great measure the situation of the building.

A butter dairy, when well constructed, consists of three apartments or rooms; one for depositing the milk, one for performing the operation of churning, and another for containing and cleaning the necessary utensils. A cheese dairy should consist of four rooms; a milk room as before, a room for making and pressing the cheese, another for the process of salting, and a fourth for stowing and preserving the cheeses, till they are ready to be brought to market. This last may be conveniently placed as a sort of loft over the other three. The milk dairy properly requires only two apartments, one for the milk, and the other for serving it out, scalding, and cleaning the different utensils. Temperature in a dairy is of the first importance; for, if too much heat be admitted, the milk will quickly become sour, and if too cold an atmosphere prevails, neither butter nor cheese making can be carried on with success.

Method of heating the dairy.

Different plans have been proposed for securing a proper degree of heat. Double walls and roof have been recommended by Dr Anderson; others have proposed hollow walls; and Mr Loudon, in his *Treatise on Country Residences*, thinks that, for common purposes, a vacuity of eight or ten inches left betwixt the wall and the lath and plaster, will be sufficient. A fountain, or *jet d'eau*, where such can be commanded, will always be a very agreeable and convenient acquisition in a dairy. Mr Marshall, who has paid much attention to this subject, advises that the walls shall be at least six feet thick, a foot on the inside to be of brick or stone, the outside to be constructed of sod, and the space between to be closely filled with earth. The roof, he says, should be of thatch, three feet thick at the least, and should project completely over the walls on each side. The materials of such a building being all bad conductors of heat, it would, he conceives, if provided with double doors, naturally preserve in this climate a temperature of about fifty to fifty-five degrees of Fahrenheit at all seasons of the year. But as the milk itself when brought in warm, would naturally tend in summer to raise the temperature too high, an ice-house is recommended to be attached to the dairy, of a simple and ingenious construction. A small quantity of ice placed when necessary in the milk room, would soon lower the temperature to any degree that might be wanted; and if the cold in winter should become too great, a barrel of hot water close stopped, or a few hot bricks placed on the floor or table of the milk room,

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would readily counteract its effects. A chaffing-dish with burning coals should never be used, as it is apt to communicate a bad taste to the milk. Many other simple and cheap forms of dairy-houses are found to answer well. Mr Marshall tells us, that in Wiltshire the rooms of the dairies have commonly outer doors, which open under a penthouse or lean-to shed. This he considers as a great advantage, for it communicates, by affording shade, a beneficial degree of coolness to the whole building.

Utensils.

The utensils required in a dairy are principally the following: milk-pails, milk-strainers or sieves, milk-cowls, coolers or pans, milk-skeels or creaming dishes, lading dishes, skimming dishes, cheese ladders, cheese vats, cheese presses, and churns. The expence of all which must evidently vary in different situations, but it is believed, that a sufficient assortment of them for a dairy of twenty cows, may, in most cases, be provided for L.25 or L.30. Wood has, in general, been employed in their construction, and is probably upon the whole the most eligible material. Lead, brass, and copper, are altogether inadmissible; for the acid contained in milk (which is now known to be the acetic) combines with these metals, and forms with them poisonous compounds. The same may be said of earthen vessels glazed with lead; and it is obvious, that true porcelain, or glass, can never come into general use for dairy purposes. Cast iron itself is far from being unobjectionable, because though the acid of milk does not form with iron a compound that is poisonous, it forms with it one, which may, in a considerable degree, alter the taste and quality of dairy products. The least objectionable of all the metallic milk dishes, are probably those which have been lately invented by Mr Baird of the Shotts ironworks, in Linlithgowshire. They are made of cast iron, softened by annealing in charcoal, so as not to be liable to break by an ordinary fall, turned smooth in the inside, and laid over with a coat of tin, to prevent the iron from coming in contact with the milk. Even these, however, we do not think quite free from objection, because, though the iron comes not in contact with the milk, the tin does; and though the acetic acid acts upon tin only in a slight degree, still it acts upon it, and forms with it a compound, which when evaporated is viscid, and has a very fetid disagreeable smell. It may therefore be supposed to injure, in some degree, the products of the dairy. The Shotts milk dishes, however, are, we understand, coming very generally into use, and Sir John Sinclair pronounces their invention, "one of the greatest improvements that has lately taken place in regard to dairy management." They are much more easily kept clean than wooden dishes, and their superior power of conducting heat, cools the milk put into them so much faster, that Sir John says, "the farmers' wives, who have given them a fair trial, affirm that they throw up one third more cream from an equal quantity of milk." They are made at the Shotts foundery, from half an English quart to twenty-four in content, and their prices are from 1s. to 9s. 6d.

It has been lately found, that slate makes very good milk coolers; and in some of the midland counties of England, the common flag, or transition slate, has been employed for this purpose.

Dairy farms.

Dairy farms, in general, consist chiefly of meadow and pasture, with only a small portion of the land under tillage. But Mr Holland, in his *Survey of Cheshire*, and Mr Curwen of Workington, in the 5th vol. of *Communications to the Board of Agriculture*, have shewn, that stall-feeding with green crops, is a most important improvement in the management of cows. In this way, they can be kept in milk not only for a month longer in autumn than by the common modes, but even through the whole winter season. Mr Curwen's extensive experiments on this subject have put the matter beyond all doubt, and it is now, we believe, pretty generally if not universally practised.

The greatest dairy farms in Britain, are found in Cheshire, Gloucestershire, Buckinghamshire, Essex, Cambridgeshire, Dorset, and Suffolk, some of the midland counties, and in Ayrshire. Essex, Cambridgeshire, Suffolk, and Dorset, are chiefly famed for butter, the rest for cheese. It is more likely that a dairy farm of no very great extent, say of ten or twelve cows, will, if well managed, be profitable, than a large concern of this sort; for the farmer's wife and daughters can more readily superintend, or perhaps perform a great part of the dairy operations themselves, when the farm is of a moderate size; and this is always better done by them, than we can ever expect it to be by hired servants. Sir John Sinclair justly remarks, that no branch of husbandry requires such constant and unremitting attention. "If," says he, "a few spoonfuls of milk are left in the udder of the cow at milking; if any one of the implements used in the dairy be allowed to be tainted by neglect; if the dairy-house be kept dirty or out of order; if the milk is either too hot or too cold at coagulating; if too much or too little rennet is put into the milk; if the whey is not speedily taken off; if too much or too little salt is applied; if the butter is too slowly or too hastily churned, or if other minute attentions are neglected, the milk will be in a great measure lost. If these nice operations," continues Sir John, "occurred only once a month, or once a week, they might be easily guarded against, but as they require to be observed during every stage of the process, and almost every hour of the day, the most vigilant attention must be kept up throughout the whole season. That is not to be expected from hired servants."

Varieties of cows.

A proper choice of cows is of the greatest consequence, because certain species of this animal, as well as certain individuals of the same species, afford vastly more abundant and richer milk than others.

All the black cattle of the island have been divided into four classes. 1. The short-horned, or Dutch. 2. The long-horned, or Lancashire. 3. The polled, or Galloway. 4. The kyloes, or Highland. But in each of these classes there are many varieties.

The cows of the first class yield much milk; those of the second less, but its cream is more abundant and richer. The same quantity of the milk also yields a greater proportion of cheese. The polled or Galloway cows are excellent milkers, and their milk is rich. A sort called the Suffolk duns, said to be a variety of the Galloways, are much esteemed for the abundance of their milk, and the excellence of the butter it produces. Two-thirds of these, with one-third of the small Alderney or French cow, (mixing the milk,) are recommended by some as the best dairy stock that can be kept. Ayrshire, or Kyle cows, are much esteemed in Scotland; and in England the improved breed of the long-horned cattle, by Mr Bakewell of Dishly in Leicestershire, is highly prized in many dairy districts. The limits of this article will not permit us to mention a variety of other good breeds that might be pointed out. Every judicious selector, however, will always, in making his choice, keep in view not only the different sorts and individuals of the animal, but also the nature of the farm on which his cows are to be put, and the sort of manufactured produce he is anxious to bring to market.

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The best age for a milk cow is betwixt four or five, and ten. When old she will give more milk, but it is of an inferior quality, and she is less easily supported.

Management of cows.

In the management of cows, two things are evidently of the greatest consequence,—to keep the animals easy, clean, and well aired; and to supply them with a sufficiency of wholesome nourishing food. It is quite certain, that if they be either over fatigued, immersed in dirt and nastiness, or deprived of the benefit of fresh air and proper food, they cannot enjoy good health; and as milk is a secretion from the animal system in its healthy state, whatever tends to impair this state must injure the secretion of the milk. When the cows are turned out to pasture, they must not be over-driven, or have so far to travel as to induce fatigue. In the house they must be carefully cleaned, and have an abundant supply of fresh air. Their food, in winter, may be of two kinds, either dry or green. Of dry food, hay and straw are almost the only kinds used; but hay is too expensive to be employed as a constant food, and even though it were not, an intermixture of green or soft food, such as turnips, cabbages, potatoes, carrots, cole and malt grains, would essentially contribute to the health of the animal; and the two most usual, and certainly the most profitable kinds of green food that can be used, are cabbage and turnips. Carrots or potatoes given once or twice a day, along with other sorts of green food, will be profitable; but no dairy cows will pay if fed solely on these. From one to two hundred pounds a day of cabbages or turnips will be consumed by a middle-sized cow; but 70 to 100 with straw, is supposed to be as much as her produce will pay for.

In summer, the best food for cows is certainly grass, and that produced by old pastures has been generally thought preferable, and often asserted to afford the richest milk. But Dr Anderson has no doubt that this is a popular error, and has often seen finer dairy products afforded by proper management, from cows fed on cut clover and rye-grass, than from such as have been kept on the finest old pastures. This part of the subject is more fully discussed under our article Butter.

Sufficient shelter from the heat of the day, and from the insects in summer, and from excessive cold or wet in winter, should of course be well attended to. Close confinement to the house, is by no means so prejudicial to the health of cows as has been often imagined. They are found to thrive equally well on stall-feeding as in the fields; but then it is essentially necessary to keep them very clean, and to comb and dress them; for if this be neglected, their legs will swell, and their health suffer.

Mr Curwen of Workington was the first who demonstrated, by actual extensive experiment, the utility of stall-feeding dairy cows. He combined steamed chaff and oil cake, with different sorts of green food, and found that, by giving a middle-sized cow two stones of green food and two of boiled chaff, with two pounds of ground oil cake and eight pounds of straw, the daily expence of her keep was only 5½d. The oil cake he found to be much more productive of milk when given with steamed chaff, than when employed without it. Varying their food from time to time, is found to be of much advantage to cows, and this may probably arise from the additional relish with which the animal eats, or from the superior excitement of a new stimulus on the different secretions.

The cows for a few weeks before calving, should have every night a little hay, or a somewhat greater allowance of green food; and on the day of calving, they should be kept in, and have warm water. For a fortnight after calving, they should have with their green food a little hay or chopped straw, with some ground or crushed oats.

The land necessary to maintain a cow may, we believe, at an average, be stated from two to three English acres, if we take into account the corn, hay, straw, and every thing else which the animal consumes. No one dairy maid can manage with propriety more than a dozen or fifteen cows.

Dairy farming in Scotland was till lately very much neglected; but there are now in that country some establishments of this sort on a very large scale. The county of Ayr was the first to set the example. But Sir John Sinclair, in his late *Account of the Scotch Systems of Husbandry*, states, that the dairy farms of Mr James Ralston, in Fineview, on the shore of Lochryan in Wigtonshire, are at present the largest concern of the kind in Scotland. He kept some time ago 120 milch cows, and is making arrangements for adding about 100 more to the number.

"They are divided," says Mr Smith, in his *Survey of Galloway*, "into lots of ten or twelve to each *byre* or cow-house, and a dairy-maid is appointed to every fifteen cows. She is allowed an assistant at milking, procured from a neighbouring village, at 1s. per week. To stimulate exertion, Mr Ralston gives a premium of two guineas to the dairy-maid who has most distinguished herself for management; and, to enable him to make a fair estimate of their comparative merits, they are appointed daily, in regular succession, to different lots of cows."

The cows are never fed out of doors till the grass has risen, to afford them a full bite. In dry and hot weather, they are housed, and fed on cut grass from six in the morning till six at night; when they are turned out to pasture for the other twelve hours. During bad weather, they are housed both night and day, and fed plentifully with turnips, potatoes, or other green food. Chaff, oats, and potatoes, are boiled for them after calving; and they are generally fed on rye-grass-hay during the latter part of the spring.

Mr Ralston says, that, about three years ago, every cow on his farm yielded annually her own weight of Dunlop cheese, which then sold at 14s. or 15s. per stone; and that he would not keep a cow that did not, in the course of the year, produce her own weight of cheese, and that would sell for the price of the cow. Sir John Sinclair states the net profit of a milk cow, in the neighbourhood of Edinburgh, at £23 per annum. Where the breeding system is followed, the profits of the dairy, in butter, cheese, and milk, are allowed to be very inconsiderable, and cannot, on an average, be estimated at more than about two guineas per cow annually, when the calves are reared. But, including the value of the calves themselves, when sold at the age of one year, the net profit of each cow may be stated at from L.8 to L.10.

The two grand dairy products are butter and cheese. Of the former we have given an account in another part of this work, under its proper title; and we now go on to observe, that

Cheese.

Cheese is a well-known article of food, prepared from milk, usually that of the cow. When allowed to stand till spontaneous acidity takes place, or when certain substances are added to milk, it coagulates and separates into two parts, a solid and a fluid. The solid is named curd, the fluid whey. When the curd is taken out of the whey, subjected to pressure, and afterwards dried for use, it constitutes cheese.

The coagulation of milk is effected by various sub-

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stances; all the acids, several neutral salts, especially those that contain an excess of acid, alcohol, sugar, gum, the gastric juice of animals, and the juice of several vegetables. The caseous matter is also separated by mere heat, when this is applied to milk in contact with the air. For then a thin pellicle is soon formed upon the surface, which, when removed, is succeeded by another, and so on for a considerable time; till at last, when the pellicles cease any longer to be formed, the remaining fluid is thin and serous.

Parmentier and Deyeux ascertained, that the matter of these pellicles is perfectly identical with pure cheese; and that the contact of the air promotes its separation merely by some mechanical action; for it was separated equally well when the milk was heated in contact with oxygen, hydrogen, and carbonic acid gas.

Substance for coagulating milk.

But the substance usually employed in dairies to produce the coagulation of milk, is a preparation of the stomach of a young sucking calf, well cleaned, and soaked in brine. An infusion of this is called rennet, runnet, or steep. And as, in cheesemaking, it is of the utmost consequence to have rennet well prepared and good, we insert the following approved method of preparing it, as given by Mr Marshall in his *Rural Economy of Norfolk*. "Take a calf's bag, maw, or stomach; and, having taken out the curd contained therein, wash it clean, and salt it thoroughly, inside and out, leaving a white coat of salt over every part of it. Put it into an earthen jar, or other vessel, and let it stand three or four days; in which time, it will have formed the salt, and its own natural juice, into a pickle. Take it out of the jar, and hang it up for two or three days, to let the pickle drain from it; resalt it; place it again in a jar; cover it tight down with a paper, pierced with a large pin; and in this state let it remain till it be wanted for use. In this state it ought to be kept twelve months: it may, however, in case of necessity, be used a few days after it has received the second salting; but it will not be so strong as if kept a longer time. To prepare the rennet for use, take a handful of the leaves of sweet briar, the same quantity of the leaves of the dog-rose, and the like quantity of bramble leaves; boil them in a gallon of water, with three or four handfuls of salt, about a quarter of an hour; strain off the liquor, and, having let it stand until perfectly cool, put it into an earthen vessel, and add to it the maw prepared as above. To this is added a sound good lemon, stuck round with about a quarter of an ounce of cloves, which give the rennet an agreeable flavour.

Dairy. Method of making rennet.

The longer the bag remains in the liquor, the stronger of course will be the rennet. The quantity, therefore, requisite to turn a given quantity of milk, can only be ascertained by daily use and observation."

A sort of average may be something less than a wine half pint of good rennet to fifty gallons of milk. In Gloucestershire, they employ one third of a pint to coagulate the above quantity.

Marshall's experiments.

As it is well known that much depends both on the proportion of rennet and the temperature of the milk, we shall present our readers with the following tabular view of Mr Marshall's experiments on this subject.

Dates.	Gallons of Milk set.	Degrees of Heat when set.	Cups of Rennet applied.	Time of Coming.	Heat of the Whey.	Covered or Uncovered.	Quality of the Curd, &c.
1781. June 5.	23	96°	2, weak	1 hour	....	.....	Delicate and good.
6.	23	96	2	1	....	.....	Somewhat tough, probably from being burnt to the kettle in which it was heated.
7.	27	94	2	2	88°	.....	Very good.
8.	26	102	1	$2\frac{1}{2}$	88	.....	Very good.
9.	25	100	$1\frac{1}{2}$	$1\frac{1}{2}$	92	covered	Good, but somewhat tough, owing, perhaps, to its being kept too warm.
10.	25	96	2	$2\frac{1}{4}$	87	uncovered	Very tender.
11.	23	100	1+	3	87	uncovered	Uncommonly delicate.
12.	24	100	2	2	89	uncovered	Uncommonly tender.
13.	28	92	3	$1\frac{1}{2}$	86	covered with a coarse linen cloth	Very good, and of a fine colour.
14.	28	100	2	$1\frac{1}{4}$	94	uncovered	Somewhat harsh, but of a good colour.
15.	28	95	2	$1\frac{1}{2}$	89	covered after three-fourths of an hour	Very good and tender.
16.	30	103 to 96 by cold water	$2\frac{1}{2}$	1	94	close covered	Pretty good, but not sufficiently tender.
17.	28	97	$2\frac{1}{2}$	$1\frac{1}{2}$	...	covered, not close	Somewhat tough.
18.	30	95	$2\frac{1}{2}$	$1\frac{1}{2}$	92	covered	Pretty good.
19.	30	92	2	...	....	covered	Very good.
21.	30	98, lowered by cold water to 95	...	...	....	.....	Curd good, cheese spongy.
23. Even.	15, warm from the cow	92	$2\frac{1}{2}$, weak	$\frac{3}{4}$	88	closely covered	Very delicate and good.
25.	40, half skim	87	3	$\frac{3}{4}$	79	slightly covered	Remarkably good of *this* sort.

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From the above table it appears, that curd of a good quality may be obtained from milk heated from 87 to 103 degrees of Fahrenheit, provided, as Mr Marshall observes, the rennet be so proportioned, that the time of coagulation be from three quarters of an hour to two hours and a half; and provided the milk be kept properly covered during the process of coagulation. "From these," continues he, "as well as from a variety of other observations which I made in the course of the summer, it appears to me, at present, that from 85 to 90 are the proper degrees of heat; and that from one to two hours is the proper time of coagulation; and that the milk ought to be covered, so as to lose, in the process, about five degrees of its original heat. Still, however, he confesses, that his observations and experiments have not been extensive enough to furnish a sufficient illustration of this very difficult subject. "Climate, season, weather, and pasture," he says, "may require that these bounds should sometimes be broken."

It would appear, from the experiments of the 7th, 8th, and 9th of June, that the quality of the curd arises as much, perhaps, from the heat of the milk when it *comes*, as from its heat when *set*; for the whey on the 9th was 4 degrees higher than that on the 8th, though the milk had been set to steep two degrees lower. Perhaps, too, a great deal depends on the curd being broken up at the critical minute, and not allowed to stand after it has come.

Mr Marshall, however, at a later period, viz. in 1788 (see his *Rural Economy of Gloucestershire*), tells us, that the following observations were accurately made by him; and the results, it must be confessed, vary considerably from those already stated; an additional proof that this process is still imperfectly understood, and that much is yet wanting to complete our knowledge of it.

"*Swindon*, Monday evening, (21st July 1788). Heat of the air in the dairy-room 60°; milk 87½°; uncovered; came in one hour 10 minutes; whey 85°; curd of a middle quality."

"*Deyhouse*, Tuesday evening. Air 63°; milk 88°; not covered; came in half an hour; 'too much rennet;' whey 86°; the curd not tender, but far from being of a bad quality."

"*Westleycot*, Wednesday morning. Air 60°; milk 86°; uncovered; came in three quarters of an hour; whey 84°; the curd of a good quality."

"*Shaw*, Wednesday evening. Air 62°; milk 87°; not covered; came in about an hour; whey 86° (quantity very great); the curd of a good quality."

"*Avon*, Thursday evening. Air 60°; milk 88°; closely covered with a thick woollen cloth, to make the top and the bottom come together; came in about an hour; whey 87°; the curd very good."

"*Foxham*, Friday evening. Air 60°; milk 91°; covered with a thin cloth; came in one hour; whey 89°! nevertheless, the curd delicately tender!!!"

When entire-milk has been coagulated by any of the above means, the coagulum afforded contains two substances; one of the nature of albumen, and the other of the nature of oil. The first is properly the cheese; the second, butter. But when cheese is prepared for the table, the butter is not separated, because it improves the taste of the cheese. The substances which coagulate milk have all been thought to act by means of the acid which they contain; but alcohol coagulates milk, and yet it contains no acid. Besides, Young, and more lately Parmentier and Deyeux, have shewn, that rennet retains its coagulating power, even when an excess of alkali is added to it.

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Action of the vegetable acids upon milk.

The vegetable acids much diluted, are observed, when added to milk, to produce more curd than the mineral acids in the same state; and this is probably owing to the superior power which the latter have of redissolving the curd or cheese. For if one part of curd, newly separated, and not dried, be mixed with eight parts of water slightly acidulated by a mineral acid, and the mixture be boiled, the curd will be dissolved, though it would scarcely have been sensibly affected by a vegetable acid thus diluted. The vegetable acids, however, in their concentrated state, dissolve curd readily, and in considerable quantity; whereas the mineral acids, when concentrated, have either very little effect on it, as the sulphuric acid; or decompose it, as the nitric. By means of this last acid, a quantity of nitrogen may be obtained from curd.

The reason why neutral salts, gums, sugar, alcohol, and acids, coagulate milk, may be partly owing to the superior affinity of these bodies for water; but this subject is very little understood. If milk be diluted by ten times its weight of water, it cannot be coagulated at all; and the reason why heat alone is insufficient for its proper coagulation, is probably owing to the great dilution of the caseous matter in the serum of the milk itself. Scheele thinks the coagulation of milk, as well as of the white of eggs, and of the lymph or serum of the blood, is owing to the combination of caloric with these substances. The alkalies, in their caustic state, when aided by heat, dissolve cheese; and ammonia dissolves it more readily than potass or soda. A few drops of pure ammonia added to coagulated milk, quickly causes the curd to disappear. The fixed alkalies, in dissolving, decompose curd; for, during the solution, ammonia is disengaged; and, if the matter held in solution in the alkali be separated by an acid, it is found to be no longer curd, but a black fatty substance like oil.

Pure caseous matter is white, solid, somewhat elastic, insoluble in cold water, but, by boiling in water, its texture is destroyed. When fresh, it is nearly insipid, but becomes acrid on keeping. If left in a moist state of the air, it very soon putrefies; but if it has been thoroughly dried, it remains a long time unchanged. Good cheese melts at a moderate heat; but bad cheese, when heated, dries, curls, and exhibits all the phenomena of burning horn. Cheese must be admitted as a principle differing in some respects from all other animal matters. It seems most analogous to albumen, as it is soluble in a fluid resembling the serum of the blood, and as it is coagulated by heat. In several of its other properties, it is analogous to fibrin, and is probably intermediate betwixt these. It is the most animalized product of the milk, and is indubitably that which is most nutritious. When shaved thin, properly treated with hot water, and mixed with quicklime, it forms a very strong and durable cement.

If milk be much heated when it is put to coagulate, and if the curd be broken, and the whey suddenly and strongly pressed out, as is often the case in Scotland, the cheese is worth almost nothing, but the whey is excellent, and will afford much butter. But when the whey is separated by a slow and gentle pressure, the cheese is good, but the whey limpid and poor. Thomson's *Chemistry*.

Milk having been adopted by the human race as food at an early period of society, it could not be very long before they discovered the use of cheese: for milk, on being allowed to stand for any considerable time, spontaneously coagulates, and separates into curd and whey. This would naturally enough suggest the idea of attempting to detach, dry, and preserve the curd; and hence, not improbably, the origin of the manufacture of cheese.

Origin and history of cheese.

In the Book of Job (unquestionably the most ancient record in the world), mention is made of cheese. "Hast thou not poured me out as milk, and curdled me like cheese;" chap. x. 10. And, in the first Book of Samuel, chap. xvii. 18, when David, while yet a youth, was sent by his father Jesse to the camp in the valley of Elah, with refreshments for his brethren, "ten cheeses," we find, were thought a proper present to their commanding officer. "Carry these ten cheeses unto the captain of their thousand, and look how thy brethren fare." Cheese was also among the supplies furnished at an after period to the same David and his troops at Mahanaim, by Shobi, Machir, and Barzillai, during the war with his rebel son, Absalom; 2 Sam. chap. xvii. 29.

Cheese is mentioned by Homer, (B. C. 907.) It formed no small part, we perceive, of the ample stock of provisions found by Ulysses and his companions in the cave of the cyclops Polyphemus.

> Ἐλθόντες δ' ἔις ἄντρον ἐθηεύμεσθα ἕκαστα·
> Ταρσοὶ μὲν τυρῶν βρῖθον, στεινοντο δὲ σηκοὶ
> Ἀρνῶν ἠδ' ἐρίφων. *Odyss.* l. ix.

> Around the grot we gaze; and all we view,
> In order ranged, our admiration drew:
> The bending shelves, with loads of cheeses prest;
> The folded flocks, each separate from the rest.

Euripides (B. C. 407), Theocritus, and other early poets, also mention cheese.

Hippocrates, who lived in the fourth century before the Christian era, speaking of the ancient Scythians, tells us, that they shook the milk of their mares in wooden vessels; and that the heavy and thick part which subsides (when the fat part rises to the surface, and the thin or serous part remains in the middle), was by them kneaded and dried, and known by the name of *hippace*. It was esteemed an excellent article of food. No doubt this was cheese made of mares' milk. Probably, though Hippocrates does not mention it, they had a method of accelerating the process, by the addition of the juice of some plant, or other coagulating substance. In another place, he expressly mentions cheese (τυρος), and says, the Scythians made it of the milk of their mares, and employed it as food. Aristotle says, that milk consists of two parts, the watery and the *cheesy*, and gives us a good deal of accurate information respecting them both. But, in another place, he incidentally, as it were, mentions a fat substance also contained in milk, which, he says, in some cases resembles oil; by which, he no doubt means the butyraceous part of milk.

According to Ludolfus, excellent cheese, as well as butter, was made by the ancient Ethiopians. Cæsar, in his *Commentaries* (L. vi. c. 22), speaking of the ancient Germans, says, "*Agriculturæ non student, majorque pars victus eorum in lacte, caseo, carne consistit.*" Strabo, likewise, (L. iv.) mentions their living upon cheese; but Pliny (L. x.) says, that though they made butter, they were ignorant of the art of making cheese. Yet the oxygala, of which he speaks, was evidently a sort of cheese; and Columella has described the manner of its preparation. In making it, the milk was usually rendered sour, and the whey was pressed out. Pliny likewise says, that oxygala was prepared from the caseous parts of butter-milk, which remained behind after the butter had been separated. Strabo, speaking of the ancient Britons, tells us, that though they had abundance of milk, some of them were so ignorant, that they did not know how to make cheese. But when he says that some of them were thus ignorant, it evidently implies that he believed others of them to be possessed of the art. Tacitus (*Ger.* cap. 23.) informs us, that the food of the ancient Germans was simple, consisting of wild fruits, fresh venison, and concrete milk (*lac concretum*). But whether by *lac concretum* he means cheese or butter, or simply curdled milk, is not known. That cheese was a common species of food among the inhabitants of ancient Rome, we learn from the first Eclogue of Virgil, where the shepherd Tityrus, addressing his unfortunate neighbour Melibœus, thus expresses himself.

> Quamvis multa meis exiret victima septis
> Pinguis, et ingratæ premeretur caseus urbi,
> Non unquam gravis ære domum mihi dextra redibat.

And, in the same inimitable poem, whilst Melibœus is driving, in despair, his exiled flock from those grounds which had been long the property of his ancestors, he is told by his friend Tityrus that he might at least have spent one night more with him; and promised, if he would still do so, pressed milk (probably cheese) as part of the entertainment.

> Hic tamen hanc mecum poteras requiescere noctem
> Fronde super viridi. Sunt nobis mitia poma,
> Castaneæ molles, et pressi copia lactis.

In modern times, the use of cheese prevails, we believe, universally, wherever human society has advanced so far as to have reached the pastoral state. No traveller with whom we are acquainted states an exception to this rule. In Europe, certain countries, and certain districts of countries, are particularly noted for the manufacture of cheese. England, Holland, and Italy, are the most celebrated countries in this respect; and in England, Gloucestershire, Leicestershire, Wiltshire, and Cheshire; as in Italy, Parma, Piacenza and Lodi are famed for their cheese. In Scotland, too, Dunlop cheese has long been highly esteemed.

Different modes of manufacturing cheese.

Of the different modes of manufacturing the principal sorts of cheese, and of their comparative merits, we have now to give some account. But, first, it is to be observed, in general, that cheese varies in quality, according as it has been made of milk of one meal, of two meals, or of skimmed milk; and that the season of the year, the method of milking, the preparation of the rennet, the mode of coagulation, the breaking and gathering of the curd, the management of the cheese in the press, the method of salting, and the management of the cheese-room, are all objects of the highest importance to the cheese-manufacturer; and yet, notwithstanding this, the practice in most of these respects is still regulated by little else than mere chance and custom, without the direction of enlightened observation, or the aid of well-conducted experiment.

In Gloucestershire, where the manufacture of cheese is perhaps as well understood as in any part of the world, they make their best cheeses of a single meal of milk; and, when this is done in the best manner, the entire meal of milk is used, without any addition from

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a former meal. But it not unfrequently happens that a portion of the milk is reserved, and set by to be skimmed for butter; and at the next milking this portion is added to the new milk, from which an equal quantity has been taken for a similar purpose. One meal cheeses are principally made here, and go by the name of *best making*, or simply *one meal* cheeses. In this county, cheeses are distinguished into *thin* and *thick*, or *single* and *double*. The last having usually four to the hundred weight, the other about twice that number.

Qualities and times of making Gloucester cheese.

Gloucester cheese is of a pleasant, mild taste, and very agreeable to almost every palate. Mr Hazard (4th vol. of the *Bath Papers*) says, that the best double Gloucester is always made from new milk, or (as it is termed by the people of this and the neighbouring counties,) "*covered milk*;" but that an inferior sort is made from what they call "half-covered milk;" and when any of these latter happen to be particularly good, they are sold by such as are not very scrupulous in their dealings, for the "best covered milk cheese;" "but honest farmers," continues he, "stamp them with a heart-shaped stamp, by which they are distinguished. The true single Gloucester cheese is thought by many to be the best in point of flavour of any we have. The season for making their thin or single cheese, is mostly from April to November; but the principal season for the thick or double, is confined to May, June, and the early part of July. This is the busy season in the dairy; for at an earlier period the milk is not rich enough; and if the cheeses be made later in the summer, they do not acquire sufficient firmness to be marketable next spring. Very good cheese, however, can be made even in winter, from cows that are well fed.

Attention requisite in milking the cows.

In this county, as well as in Wiltshire, and some others, they milk their cows in summer at a very early hour; generally by four o'clock in the morning, before the day becomes warm, and the animals restless and unruly. They are again milked in the evening about the same hour. Nothing requires greater attention than this operation, from every farmer who would profit by his dairy. It should never be confided to the management of common servants. The farmer himself, or some trusty person for him, should always superintend it. For if a cow be not properly milked, it is perfectly well known that her milk will not only be gradually diminished in quantity, but she will be in danger of going dry altogether; and moreover, become liable to diseases in consequence of the reabsorption of the milk. Besides, it has been proved, that the last drawn parts of the milk are vastly superior in quality to the first, and therefore ought not by any means to be lost.

One meal cheese.

When a one meal cheese is to be made, (and it will be for the interest of every farmer to make one if he has a sufficient number of cows,) the rennet is put to the milk in a large vessel called a cheese-tub, immediately on its being brought in warm from the cow. As soon as coagulation has taken place, the whey is carefully strained from the curd, and this is broken small and equally by the hand. It is then by little and little, (breaking it all the while,) put into a vat, a strong vessel commonly made of elm, and adapted to the size and form of the intended cheese. The vat is filled an inch or more above the brim. This is done to prevent the curd from shrinking below its sides when the whey is squeezed out; for if the curd should thus shrink, the force of the press being henceforth sustained by the brim of the vat, the cheese would be uninfluenced by it, and good for little. Previously, however, to the curds being put into the vat, a cheese-cloth or strainer is spread over it, and is so large as to be sufficient when turned up to envelope the whole cheese. A smooth round board, about an inch thick, is then laid on the vat, and the whole put into a press to remain for two hours. It is then taken out, and the cheese turned over. A clean dry cloth is substituted for the wet one, and the press is again applied for six or eight hours more. The cheese is now turned a second time, and rubbed on each side with salt. A dry cloth being again furnished as above, it is a third time put into the press, and allowed to remain for twelve or fourteen hours. At this period of the process, if any of the edges happen to project, they are paired off; and the cheese being laid upon a dry board, is regularly turned every day. To allow the escape of the whey, holes are generally made in the lower part of the vat; for it is quite necessary that every drop of the whey should be expelled.

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Method of managing in the press.

Skewering.

When cheeses of a large size are made, iron skewers are thrust in various directions, through holes in the sides of the vat into the curd, to facilitate, when withdrawn, the escape of the whey; and this is done repeatedly during the first day of pressing.

Marshall's observations on vats and press.

Mr Marshall justly observes, that in every cheese dairy there should be vats of various sizes constantly in readiness. For if this be not the case, the dairy-maid will often be limited in her choice, and unable to adapt the vat or vats she employs to the quantity of curd she happens to have in her cheese-tub; and the addition of a little overplus curd, which has been kept from meal to meal, often spoils a whole cheese. Besides, when three or four cheeses are made at a meal, a number of vats come to be actually in use. He observes, with no less truth, that a great deal depends on the proper construction of the press and its power. "If," says he, "it does not press level, if it has too much play so as to incline or become tottering or leaning one way or another, and do not fall perpendicular upon the cheese-board, one side of a cheese will frequently be thicker than another; and what is still worse, one side will be thoroughly pressed, while the other is left soft and spongy." Its power may be given by a screw, by a lever, or by a dead weight, and ought to be proportioned to the thickness of the cheese. "I had one," says he, "constructed on the above principles, the power a dead weight of stones contained in a cubical box, moving in grooves, so as to keep its bottom horizontal, the medium weight 1 cwt. 2 qrs. but regulated by the stones agreeably to the thickness of the cheese or cheeses to be pressed."

Method of colouring cheese.

As most people have attached the idea of excellence to cheese of a high yellow or orange colour, the farmer, who would dispose of his cheese to advantage, is in a great measure necessitated to impart such to what he offers for sale. It is done by means of a preparation from the *Bixa orellana* of Linnæus, commonly called Spanish *annotto*. The red pulp, which covers the seeds, is suspended in hot water, allowed to subside, dried, and formed into cakes or balls. These are set aside to dry more completely, and become perfectly firm. An ounce of this substance, when genuine, is sufficient to colour a hundred weight of cheese; and this is the proportion usually employed in the county of Gloucester. They rub a piece of the annotto upon a smooth stone kept for the purpose, and then mix it thus levigated with the milk previously to applying the rennet. It adds nothing to the goodness of the cheese,

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but being perfectly harmless, no bad consequences can arise from its use. The quantity employed is very generally judged of by the shade of colour to be imparted, without any very certain rule; and the degree of colour in most cases is adapted to the name under which the cheese is intended to be sold. In north Wiltshire, says Mr Marshall, a new species of prepared annotto has lately been discovered, which gives the milk and the curd a beautiful yellow hue.

Skimmed milk cheese is made only in those districts where butter is the chief object; and the milk is used after it has been two or three times skimmed.

Cheshire cheese.

In Cheshire, where they make cheeses of the largest size, (60 or 100 pounds,) they milk their cows in summer at six o'clock morning and evening; but in winter, at day-light in the morning, and just before dark in the evening. After the milk has been strained to free it from any impurities it may have caught during the milking, it is conveyed into a cooler placed upon feet like a table. This is a leaden cistern, nine inches deep, five feet long, and two and a half wide, with a cock or spigot at the bottom for drawing off the milk. This, when sufficiently cooled, is drawn off into pans, and the cooler again filled. In some cases the cooler is large enough to hold a whole meal's milk at once. The rapid cooling thus produced (which, however, is necessary only in hot weather and during the summer season,) is found to be of essential utility in retarding the process of fermentation, and thereby preventing ascescency from commencing in the milk before two meals of it can be put together. Some have thought that the cheese might be improved by cooling the evening's milk still more rapidly; and that this might be effected by repeatedly drawing it off from, and returning it into the cistern. When the milk is too cold, a portion of it is warmed over the fire and mixed with the rest.

Milking and cooling the milk.

Meals of milk to a cheese.

A cheese in this county is seldom made of one meal. And even when two cheeses are made in the day, (that is, one in the morning and another in the evening,) two meals of milk are generally put together. Nay, in the beginning and end of the season, when the cows do not afford so large a quantity, or when there are fewer of them in milk, even three, four, or sometimes five or six meals are employed in making one cheese. Now, as the goodness of cheese depends greatly on the quantity of cream left in the milk, and as cream necessarily separates from milk on being allowed to stand, it has been doubted by some, whether cream, once separated, can be again so intimately united with milk, as not to undergo decomposition in the after process of making cheese. From some idea of this sort, it has become customary to withdraw a part of the cream from the evening's milk, when a two-meal cheese is to be made in the morning. But the best farmers condemn this practice, reunite the whole cream to the milk, and believe that when thus again blended, the mixture differs in no respect from new milk, in as far as cheese-making is concerned. The test of experiment, however, is necessary to decide this point. If a cheese, made in the morning wholly of the night's milk, on which the cream had risen, be found to be as rich and good as one made of new milk, all the other circumstances being the same, we shall have a proof that milk and cream after being separated, may be again so united as to become the same as new milk. All agree, that in making a one meal cheese of the best quality, no part of the cream should be abstracted. The cheese is sometimes made in the evening, but most frequently in the morning. When two meals of milk are used, unless the weather be very hot, a portion of the creamed milk of the former meal, as a half, a third, or more frequently only three or four gallons are reserved, and being placed in a brass pan over a furnace, or in a vessel of hot water, is made scalding hot. Half of it is then poured into the cheese tub among the cold milk, and the remainder into the pan in which the cream of this same milk had been placed. The hot milk and cream being now intimately mixed, are poured into the cheese tub, and the warm milk added that had just come in from the cow. This is called *melting the cream*, and is thought to be the best method known of uniting two or more meals of milk. The rennet is now applied. In making cheeses of the inferior kind, as from skimmed milk, where, from its tendency to acidity, there is a risk that it will break or curdle while over the fire, the whole is brought to a proper temperature by the addition of hot water.

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Colouring

The colouring matter (annotto) in Cheshire, is added by tying up as much of the substance as is thought sufficient in a linen rag, and putting it into a half pint of warm water to stand over night. The whole of this infusion is, in the morning, mixed with the milk in the cheese tub, and the rag dipped in the milk and rubbed on the palm of the hand as long as any of the colouring matter can be made to come away.

Temperature on coagulation.

The temperature of the milk when coagulating, we have already shewn to be of the greatest consequence; and yet in this point there are scarcely two dairies whose practice is the same. In those of Cheshire it is commonly estimated that the lowest degree of heat which the milk ought to have when the steep is put to it, is one half of what it has when newly drawn from the cow; and the highest about twice the natural warmth. It is thence concluded, that when a one meal cheese is to be made, no great error will be committed, if by the time a large dairy of cows has been milked, and the milk deposited in the tub for coagulation, the rennet be immediately applied. But this, it must be evident, is a very uncertain rule, seeing it is liable to be influenced by the season of the year, the state of the weather, and the time employed in milking. Universally, therefore, in all dairies where cheese of a superior quality is produced, the milk is coagulated at a fixed degree of heat; that, namely, which has been found by experience to be the best. Mr Rudge is of opinion, that the average temperature necessary to be observed, may be betwixt blood and summer heat, or 90° of Fahrenheit. But the experiments of Mr Marshall, formerly stated, seem to be the most satisfactory on this subject. It is found, however, that milk produced on poor clays requires to be coagulated at a higher temperature than that which is produced from rich pastures. Something, therefore, it would appear, does depend upon the pasture in cheese-making as well as in the making of butter, though not nearly so much, we know, as on management in both these operations.

Gathering the curd.

As soon as coagulation has taken place, the curd is broken and gathered. Various methods of doing this prevail. The following seems to be judicious. A cheese knife is employed to cut the curd in various directions, and this being allowed to subside for a short time, is again cut by the knife more freely than before, and the operation continued till the whole be reduced to small uniform particles. This business may occupy about the space of forty minutes; after which the cheese tub is again covered with a cloth, and allowed to remain for nearly the same time. When the particles have subsided, the whey is laded off, and the curd properly pressed, by the bottom of the skimming dish, the hands,

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or a semicircular board and weight, adapted to the size of the tub. The cheese knife is now employed as before to cut or pare the curd, thereby promoting the free separation of the whey; and pressure is again applied till it be all drained off. The curd is then put into two or three separate vessels, and the dairy-maid and her assistant break it with their hands as small as possible. During this part of the process, salt is scattered over the curd, and intimately mixed with it. The proportion of salt is not well ascertained, and is regulated merely by estimation.

Breaking and vatting.

Sometimes the skimming dish and hand only are used in breaking the curd, particularly when the milk has been set to steep rather cool, and the curd is of course tender. When it has been properly broken and salted, it is collected into the cheese vat; and this is done in the same manner as formerly described. When turned in the vat previously to its being put into the press, it is rinsed with warm whey, and wrapped in a finer cloth; pains being taken to put the edges of the cloth completely within the vat, so as perfectly to inclose the whole cheese.

Binding, filleting, and managing in the press.

To prevent squeezing over the sides of the vat when the press is let down, a hoop or binder of tin or white-iron, about three inches in breadth, is put round the cheese, and the lower edge of it placed within the brim of the vat. Sometimes cheese fillets of a coarse sort of strong broad tape are used instead of the tin binders. One end of the fillet is thrust down with a wooden knife betwixt the cheese cloth and vat, and then drawn tightly several times round the cheese and fastened with strong pins. The operation of skewering commonly continues till the morning after the cheese has been put in the press, and the oftener it is turned and shifted during that interval the better. Seldom is it allowed to remain more than half an hour, never above two or three hours after its being first put to the press till it be again taken out. The cheese or cheesling is now placed without its cloth in a vessel of hot whey or water, to stand for an hour or two. This is to harden its skin and prevent blistering. It is then wiped dry, and covered with a clean dry cloth; again placed in the vat (which is also wiped dry), and put under the press. Sometimes to allow the escape of extricated air, and prevent blistering, the upper surface of the cheese at the two first turnings is pricked all over with a small bodkin an inch or two deep. It is taken out, wrapped in a clean dry cloth, and replaced in the vat twice a day at least, during two days, when it is finally removed. In the two last turnings, cloths of a finer texture are employed, that no mark of them may remain on the cheese. Some think it necessary to bare-vat the cheese, in order that every mark of the cloth may be effaced.

Salting.

The next operation is salting; and this is done, either by laying the cheese immediately after it comes out of the press on a clean fine cloth in the vat, immersed in brine, to remain for several days, turning it once every day at least; or by covering the upper surface of the cheese with salt every time it is turned, and repeating the application for three days successively, taking care to change the cloth twice during the time. In each of these methods, the cheese, after being so treated, is taken out of the vat, placed upon the *salting-bench*, and the whole surface of it carefully rubbed with salt daily for eight or ten days. If it be large, a wooden hoop or a fillet of cloth is employed to prevent renting. The cheese is then washed in warm water or whey, dried with a cloth, and laid on what is called the *drying-bench*. It remains there for about a week, and is thence removed to the keeping-house. In Cheshire, it is found that the greatest quantity of salt used for a cheese of sixty pounds is about three pounds; but the proportion of this retained in the cheese has not been determined.

Management in the store-house.

When after salting and drying, the cheeses are deposited in the cheese-room or store-house, they are smeared all over with fresh butter, and placed on shelves fitted to the purpose, or on the floor. During the first ten or fifteen days, smart rubbing is daily employed, and the smearing with butter repeated. As long, however, as they are kept, they should be every day turned; and the usual practice is to rub them three times a week in summer and twice in winter.

The cheese-rooms in Cheshire are generally placed over the cow-houses. This is done to afford them, from the heat of the cattle below, that uniform and moderate degree of temperature which is supposed to be essential to the proper ripening of the cheese. Dry coarse grass or rushes are placed as litter on the floor.

Mr Marshall's method.

Such are the most approved methods in the principal cheese districts. But others are also practised. The method detailed by Mr Marshall in his *Rural Economy of Norfolk*, as the one which he himself followed, appears to us so good, that we deem it right to lay it before our readers. "The practice," says he, "in my dairy, has been uniformly this: As soon as the curd is come at the top firm enough to discharge its whey, the dairy woman tucks up her sleeves, plunges her hands to to the bottom of the vessel, and, with a wooden dish, stirs the curd and whey briskly about; she then lets go the dish, and by a circular motion of her hands and arms, violently agitates the whole; carefully breaking every part of the curd; and at intervals, stirs it hard to the bottom with the dish, so that not a piece of curd remains unbroken larger than a hazel nut. This is done to prevent what is called *slip-curd*, (that is, lumps of curd which have slipped unbroken through the dairy woman's hands,) which, by retaining its whey, does not press uniformly with the other curd, but in a few days (if it happen to be situated toward the rind,) turns livid and jelly-like, and soon becomes faulty and rotten. This operation takes about five or ten minutes; or, if the quantity of curd be large, a quarter of an hour.

"In a few minutes the curd subsides, leaving the whey clear upon the top. The dairy woman now takes her dish, and lades off the whey into a pail, which she empties into a milk-lead to stand for cream, to be churned for whey butter; a practice peculiar to the cheese counties, and which forms no inconsiderable part of the profit of a dairy in those counties.

"Having laded off all the whey she can, without gathering up the small pieces of loose curd floating near the bottom of the vessel, she spreads a straining cloth over the cheese tongs, and strains the whey through it, returning the curd retained in the cloth into the cheese-tub. When she has got all the whey she can, by pressing the curd with her hand and the lading-dish, she takes a knife and cuts it into square pieces, about two or three inches square. This lets out more of the whey, and makes the curd handy to be taken up, in order to be broken into the vats.

"Having made choice of a vat or vats proportioned to the quantity of curd, so that the cheese when fully pressed, shall neither over nor under fill the vat, she spreads a cheese-cloth over the vat, into which she rebreaks the curd, carefully squeezing every part of it with her hands; and having filled the vat heaped up and rounded above its top, folds over the cloth, and places it in the press."

Scalding.

In autumn when the weather got cool and moist, the curd was *scalded*, "to make the cheese come quicker to hand," (that is, sooner saleable,) and to prevent a white woolly coat from rising. It is done thus: If the cheese be made from new milk, scalding water (boiling water with a small quantity of cold whey mixed with it,) is poured over the whole surface of the curd as it lies at the bottom of the cheese tub. *—If from skimmed or other inferior milk, the outsides only are scalded, after the curd is in the vat, by first pouring the scalding water on one side, and then, turning the cheesling, pouring it on the other." "Supposing," says Mr Marshall, "the cheesling to be made on Monday morning at seven o'clock, it is between eight and nine taken out of the vat, the cloth washed, and immediately placed in the press again. On Monday evening it is salted, and, if wanted, pared; put into a dry cloth, and replaced in the press. On Tuesday morning, it is bare-vatted, or the cloth changed; the cheesling in either case being turned, and again put into the press. On Tuesday evening it is again turned; and on Wednesday morning finally taken out of the vat and press."

Production of the *blue coat* in cheese.

As soon as the cheeses become firm enough to be handled with safety, he causes them to be well brushed with a hard brush frequently dipped in whey; and when nearly dry, rubbed over with a cloth on which fresh butter had been spread. He has them thus washed, scraped, rubbed, and turned once a-day for some weeks, "till they acquire a rich golden polish, and the *blue coat* begin to shew itself." This will be regulated not only by the age of the cheese, but by its quality, and the state of the weather, therefore no certain number of cleanings can be fixed; and the *blue coat* will appear perhaps before one month, perhaps not till the end of two or even three. The cheeses, however, ought to be regularly scraped and rubbed until they be perfectly smooth, and the rind mellowed with butter, whenever it gets dry and harsh. The blue coat is that desirable appearance of a cheese, which is at once a criterion of its goodness, and of the skilfulness of the dairymaid.

Method of making Parmesan cheese.

The Italian cheese called Parmesan, so highly prized, is, according to Mr Benjamin Pryce and Mr Arthur Young, who observed the operation on the spot, made entirely of skimmed milk, and the process conducted as follows. Two meals, the evening's after it had stood sixteen hours, and the morning's about six, were put together. At ten o'clock, this milk, consisting of about 264 English quarts, was suspended in a large copper, by a crane over a slow wooden fire. When an hour had nearly elapsed, the milk, having been frequently stirred, was about 82° of Fahrenheit, and the heat of the atmosphere at the time was 70°. The cazaro, or dairyman, took a ball of rennet like a large walnut, and squeezed it through a cloth into the milk, which was all the while stirred. He then removed the copper from off the fire by means of the crane, and a few minutes past twelve the rennet had operated. The coagulated milk was freely stirred up, and allowed to stand for a little till the whey should in some degree separate. At one, the cazaro ordered his sotto-cazaro to work the curd, which he did with a stick properly armed with cross wires. The curd being reduced to a small grain, and left to subside till the whey was nearly clear on the surface; part of this was taken out, and the copper again turned over the fire. It was now brought to a heat somewhat below boiling, and a quarter of an ounce of saffron added, to impart a slight degree of colour. All this while, the curd was stirred with a wooden instrument, to prevent singeing or burning; and the cazaro from time to time examined it betwixt his finger and his thumb, to mark the exact moment when it should have attained sufficient firmness and solidity. The heat was $124\frac{1}{2}$ of Fahrenheit. It is, however, often raised considerably higher.

When the small grains of curd felt as firm as the cazaro wished, (which was in about an hour and a half,) the copper was taken from the fire, and the curd allowed to subside. The cazaro then drew off about three-fourths of the whey; poured round the bottom of the copper three or four gallons of cold water, to cool it so far as that he might be able to handle the curd, and slid below this a cloth, by which he brought it up and placed it in a tub to clear. When drained, it was put into a hoop, and about half a hundred weight laid upon it for an hour. The cloth was then removed, and the cheese placed again in the hoop, and put upon a shelf.

Their practice is to allow it to remain there for two days, at the end of which period it is sprinkled all over with salt: and this is repeated every two days, for thirty days successively if it be summer, and forty if it be winter; after which no farther attention is requisite. During the process of salting, they place two cheeses on one another, in which situation they are supposed to take the salt better than when single. They are afterwards scraped clean, turned in the magazine once every day, and rubbed with linseed oil, to preserve them from insects. They are never sold till they have been kept six months.

Parmesan of ewe's milk.

After the cheese has been made as before described, the morning's butter-milk is added to the whey, a fresh coagulation produced by means of an acid, and a sort of cheese made called Maschopino. At Rochefort in Languedoc, they make Parmesan of ewe's milk; and in other places it is usual to add a certain portion of ewe's or goat's milk to that of the cow.

Stilton cheese.

Stilton cheese is made by putting the night's cream into the morning's new milk along with the rennet. When the curd is come, it is not broken as in making other cheese, but taken out whole and put into a sieve to drain gradually. Whilst this is going on, it is gently pressed; and having become firm and dry, is put into a vat, and kept on a dry board. These cheeses are exceedingly rich and valuable. They are called the Parmesan of England, and weigh from six to twelve pounds. Their most usual name is *cream cheeses*. The manufacture of them is confined almost exclusively to Leicestershire, though not entirely so.

Many persons in Huntingdonshire, Rutland, and Northamptonshire, make cheeses of the same sort, and sell them for Stilton cheeses. Stilton, every body knows, is only a place of sale, no cheeses being made within many miles of it. Some make them in a net like a cabbage-net, and give them the form of an acorn. They are not sufficiently mellowed for use, till two years of age; and will not sell unless decayed, blue, and moist. In order to hasten their maturity, it is a common trick to place them in buckets, and cover these over with horse dung. Wine added to the curd brings on a rapid advance of ripeness in cheese. As the thinner cream cheeses are named Stilton, so there is a thicker sort called Cottenham cheese. Of late, attempts have been made to follow a French fashion regarding these cheeses.

Attempts to imitate French cheeses.

* The curd will be more equally affected by the scalding fluid by throwing that when broken into the fluid, than by pouring the fluid upon the curd. Scalding is done with the fluid from 102° to 140° and 192°.

Dairy.

In France it is common to mix particular plants and herbs in their cheeses. Now we have likewise in this country cheeses *aux fines herbes, à l'Estragon, au Capucin*, &c.

Lincolnshire cheese.

In Lincolnshire, they make a rich and excellent cream cheese, by adding the cream of a former meal of milk to that which comes immediately from the cow. The cheese is gently pressed only two or three times; and when but a few days old, is sold to be eaten with radishes, sallad, and the like.

Green cheese.

Green cheese is made by steeping over night in a proper quantity of milk, two parts of sage with one of marigold leaves, and a little parsley after being bruised, and then mixing the curd of the milk thus *greened*, as it is called, with the curd of the white milk. These may be mixed irregularly or fancifully, according to the pleasure of the operator. The management in other respects is the same as for common cheese. These are mostly made in Wiltshire.

Dunlop cheese.

In Scotland, a species of cheese is produced, which has been long known and celebrated under the name of Dunlop cheese. The appellation is derived from a parish of the same name in Ayrshire, where this cheese was first made; but its manufacture is at present by no means confined to Dunlop. Many of the neighbouring parishes now make cheese equally good, and in far greater quantity. Indeed, when once the cheese from any part of the county is carried to a distance, it is called Dunlop cheese.

When introduced.

Making of cheese from unskimmed milk, or as it is termed, *sweet milk*, seems hardly to have been known in Scotland before the revolution. It was about this time, that a woman of the name of Barbara Gilmour, who had fled to Ireland from religious persecution, returned to Dunlop, and introduced the above manufacture. Her great-grandson is still living, and possesses the same farm.

Dunlop cows.

In this district, their cows are of a small rather than a large size; from 30 to 50 stone live weight. Particular attention is paid to their breed; and being fed in inclosures, they are never under a roof, except it be for milking, from May to October. Existing thus in the open air during all the mild part of the year, the animals probably enjoy the best health, and their milk is of the finest quality. They also afford it in large quantity, and are milked twice a-day, viz. at six, morning and evening. Some of them for two or three months after calving, have produced from 18 to 20 Scotch pints of milk per day, that is, from 9 to 10 English gallons; but this is rare, and the milk of such cows is usually thin and serous.

Method of making Dunlop cheese.

The best cheese is made by such as have a dozen or more cows, and consequently can make a cheese every day; one half of the milk being immediately from the cow, and the other of twelve hours standing. Their method of making it is simple, They endeavour to have the milk as near as may be to the heat of new milk when they apply the rennet, and whenever coagulation has taken place, (which is generally in ten or twelve minutes,) they stir the curd gently, and the whey beginning to separate, is taken off as it gathers, till the curd be pretty solid. When this happens, they put it into a drainer with holes, and apply a weight. As soon as this has had its proper effect, the curd is put back again into the cheese tub, and by means of a sort of knife with three or four blades, cut into very small pieces, salted, and carefully mixed by the hand. It is now placed in the vat, *chessel*, or *cheesitt*, as it is named in Scotland, and put under the press. This is commonly a large stone of a cubical shape, from half a ton to a ton in weight, fixed in a frame of wood, and raised and lowered by an iron screw. The cheese is frequently taken out, and the cloth changed; and as soon as it has been ascertained that no more whey remains, it is removed from the chessel altogether, and placed on a dry board or deal floor. It is turned and rubbed frequently with a hard coarse cloth, to prevent moulding, or breeding mites. No colouring matter is used in making Dunlop cheese, except by such as wish to imitate the English cheese.

Cheese in different parts of Scotland.

Excellent cheese, little if at all inferior to Dunlop, or even to some of the best English manufacture, has lately been made in Dumfries-shire, and some of the other southern counties of Scotland. A very good kind of plain cheese has been made on a farm near Thurso, in the north of Scotland, for a few years past; and in a particular district of Ross-shire, good cheeses are made, but not for sale. They have a singular mode of improving them, by burying the cheeses separately for some time within high-water mark. This makes them become blue, moist, and rich tasted, like Stilton.

Size of Dunlop cheeses.

The usual size of Dunlop cheeses is from 20 to 60 pounds; and a dozen good cows, well fed and managed, will produce in a season from 150 to 160 stones (provincial weight), that is, more than a ton and a half. This, when brought to market, at the rate of 10 to 12 shillings per stone, may produce from 70 to nearly 100 pounds sterling.

Defects of cheese.

Cheeses in general are liable to crack, to acquire rankness and pungency, to heave, to blister, and to run out at the sides. The first has been thought to arise from too suddenly exposing them to a current of air on their being taken out of the press. Rankness and pungency are commonly attributed to impure rennet, or to a deficiency of salt; but it is more probably owing to the imperfect separation of the whey. Heaving and running out at the sides, are properly attributed to the same cause, though some ascribe them to the rankness of certain pastures, or an improper temperature of the cheese house.

Remedies.

The usual remedy for blisters, is to cut them open and pour hot water into the incisions; then to press down the outer rind, putting on a little salt and a piece of slate loaded with a ten or twelve ounce weight. To prevent sponginess, or whey-spring in cheese, careful breaking of the curd, frequent skewering, and powerful pressing, are esteemed the best means. It is observed, however, that often from the same curd, a net cheese which has been scarcely pressed at all will be quite close, when one that has been strongly pressed will heave. This may not be easily accounted for; but certainly it appears to us, that a great error is committed in the usual method of pressing cheese. Holes, it is true, are generally made in the lower parts of the vat, to admit the escape of the whey; but as soon as the curd has been put in, the whole force of the press is applied at once; and the consequence is, that the curd is so strongly forced into the holes, that these are altogether plugged up, and might as well have never been made. The power of the press ought to be applied gradually. A screw might be the best method of effecting this; but even by means of a lever it could be very easily accomplished. We have only to suspend a weight on the lever at a proper distance from the fulcrum, so as to counteract, as far as may be thought necessary, the weight of the body employed as a press, and by moving gradually the counteracting weight nearer and nearer to the fulcrum, or point of support of the lever, the pressure would be thus slowly laid on.

Observations on pressing.

Dairy.

Cheese from the milk of different animals.

The ewe.

Though cheese be generally made from the milk of the cow, yet there are other animals from whose milk it can, and indeed frequently is procured. The Scotch make cheese from the milk of the ewe, and it is in considerable esteem for its rich, sharp, agreeable, flavour. The curd of ewe's milk has a fat viscid appearance, and is not so easily brought to assume a firm consistence as the curd of cow's milk.

It would appear that the practice of milking ewes, though still followed in many parts of Scotland, was much more prevalent there formerly than it is at present. Few customs are oftener alluded to in all the old pastoral ballads and songs of the country. The allusions to it in the "Gentle Shepherd," are well known, and in the beautiful ballads of "The Flowers of the Forest," and "Ewe bughts, Marion."

Allusions to ewe milking.

The goat.

Goats' milk, when the cream is separated, coagulates with the same facility as cows' milk, and yields a larger proportion of curd. It makes very excellent high-flavoured cheese, of a meagre appearance, but delicate relish; it resembles Parmesan. Frequently a portion of ewes' or goats' milk is added to the cows' milk, and is thought by many to improve the cheese very much. Mares' milk, when creamed, coagulates precisely as cows' milk, but the curd is not so abundant: The Tartars make cheese of it. From asses' milk, alcohol and acids separate a small proportion of curd, which has but little consistence, and could not be easily made into cheese.

The mare.

The ass.

Woman's milk.

Womans' milk cannot be coagulated by any of the methods employed in coagulating the milk of the cow; yet there can be no doubt that it contains curd; for if it be boiled, pellicles form on its surface, which have all the properties of curd; and it evidently coagulates in the stomachs of infants, as appears from what they occasionally eject by vomiting. Probably the cause of its not coagulating in the usual way, is the great quantity of water with which it is diluted.

Rein-deer.

The Laplanders make both butter and cheese of the milk of the rein-deer.

Not only does the milk of one genus of animal differ from that of another; but the milk of different varieties, and individuals of the same species, is found to be very different. The variety, or breed of the cow, therefore, which we employ on a cheese farm, is of much consequence; and every judicious farmer will take care to have that sort of cow which experience has shewn to be the best. In selecting or rearing his cow stock, he will have regard not only to the quantity and quality of the milk they afford, but to a third circumstance, namely, the fitness of the animal in point of hardiness for the situation in which it is to be placed. In this last respect the long-horned breed are much better than the short-horned, and most of the Scotch kinds are probably superior to either. The Alderney cow is highly esteemed. From the milk of this sort, Mr Marshall made cheese of a texture almost as close and firm as bees-wax, and nearly as high coloured. They were as different in quality and appearance from the produce of the long-horned cow, as if they had been a distinct species of animals. Individual cows also, of the same kind or variety, differ greatly in the quality no less than the quantity of their milk.

Varieties of milk.

Of cows.

The average quantity in the principal cheese districts may be stated at eight to twelve quarts a day; but this must obviously vary according to the mode of feeding and treatment, even in the same animal. Many cows will give twice the quantity above stated for a short period; but then they either soon go off their milk, or it has less richness than that of others.

Dairy.

Average quantity of milk from a cow.

Influence of pasture.

Pasture has also been thought to have great influence on the quality of milk, and consequently on the cheese made from it. It is commonly believed that old lands, that is, such as have been long out of tillage, produce milk which gives the best and the largest quantity of butter, and that such as have been more recently laid down in grass are the best for cheese. "The same cow," says Mr Rudge, in his *Survey of Gloucestershire*, "on two pastures, separated only by a hedge, will give milk of different qualities; from one shall be made fine rich and close cheese, while from the other shall be made rank, heaving, hollow cheese, unpleasant to the palate, and unfit for the market." He tells us, that in the parish of Haresfield, two grounds adjoining each other were used alternately for the pasture of some cows; and that while they were on the one, excellent cheese was made from them, but, on the other, it was difficult to make any that was tolerably good. The one was old pasture, and the other had been lately dressed with manure, and under tillage.

Noxious plants.

It is perfectly conceivable that there may be plants which thrive in new pastures, but disappear in the old; and we know that there are plants which, when eaten by the cows, greatly affect the nature of their milk. Wild garlic, for example, and the *brassica rapa*, or common turnip, give a disagreeable flavour to both butter and cheese; * and there may be many others, which, though not so palpable in their effects, are also noxious. White clover, (*trifolium repens*,) and almost all the species of crow-foot, (*ranunculus*,) are thought to be of this sort. But though we allow to certain pastures some effect in determining the quality as well as the quantity of the milk, still we are fully persuaded that far more depends on the management of the operator, than on this circumstance, in the production of good cheese. This is the opinion of the acute and experienced Dr Anderson, and we have had ourselves such opportunities of observing the effects of different sorts of management, that we have no doubt whatever of the justness of his sentiments. He well remarks, that mankind are always ready to lay the blame of failure on any thing rather than their own misconduct.

Cleanliness.

Of all the parts of dairy management, cleanliness is the most indispensible. "It is indeed," says Mr Donaldson, "not only necessary in dairy-husbandry, but the very foundation of it. A farmer may be in possession of the most valuable breed of cows, and these be fed in the richest pastures; but unless cleanliness prevail in the dairy, his butter or his cheese will never stand high in general estimation." Cleanliness chiefly consists in regularly scalding, scrubbing, rinsing, and drying the floors, shelves, and different implements used, so as to prevent acidity.

Quantity of cheese from a cow.

The quantity of cheese produced from a given number of cows, is differently stated in different districts. Some think $2\frac{1}{2}$ cwt. from each cow, a good average annual return. Others vary the estimate from this to 4 cwt. Mr Rudge, in his *Agricultural Report of Gloucestershire*, states the annual produce of each cow at $3\frac{1}{2}$ to $4\frac{1}{2}$ cwt. The annual produce of a dairy

* It is now we believe ascertained, and pretty generally known, that a small quantity of saltpetre, added to the milk while warm from the cow, entirely removes the disagreeable flavour arising from the use of turnip.

Dairy.

of 20 cows he calculates at L. 136, 10s. allowing 4 cwt. from each cow. He is of opinion that the profits of a well managed dairy may arise, in a considerable degree, from the feeding of hogs; but when these are not kept, the whey, he says, is valued and sold at L. 2 annually for each cow.

Quantity of cheese made in Berkley vale.

The actual quantity of cheese made in any particular district is not easily ascertained with accuracy. Marshall estimates the produce of the Vale of Berkley at about 1100 tons annually; and he says that, in 1788, at Barton fair, (the great yearly market for cheese, held on the 28th of September in Barton-street, Gloucester,) there were 40 waggon loads of cheese. The prices, however, he remarks, were almost 25 per cent. lower than they had been known to be for many years before, cheese being then a drug. The worst *two meal* cheese sold at a guinea, and the best *one meal*, at 30s. He mentions one factor, or copartnership of factors, who were said to send seven or eight hundred tons every year to the London market.

The Gloucestershire *one meal* cheese is principally bought by cheese factors, who live in and near the district, and sent to the London market; and the *two meal* cheese is consumed chiefly in the manufacturing districts of this and other counties. It sells about ten shillings a hundred weight cheaper than the other. Some of it goes to the London market, and is there probably sold under the name of Warwickshire cheese; an appellation often given to cheese which is in fact the produce of several counties. The cheese is bought by the factors from six weeks old and upwards.

Species made in Britain.

Many species of cheese are produced in this island; but our markets are filled chiefly by two sorts; the one of a dry loose texture, and of a rough austere flavour; the other of a texture close and wax-like, and milder to the taste. The former is sold under the name of Cheshire cheese, and is, we believe, chiefly the produce of that county and of Lancashire; the latter under the name of Gloucestershire cheese, provided its quality entitle it to that distinction; if not, it generally takes the name of Warwickshire cheese. Indeed the county of Gloucester could not produce one fourth part of the cheese usually sold under this name. The number of Cheshire cheeses has greatly decreased within the last ten years.

The products of Somersetshire, Wiltshire, Berkshire, Oxfordshire, Gloucestershire, Worcestershire, Warwickshire, Leicestershire, Staffordshire, Derbyshire, Durham, and Yorkshire, are very similar: all of them as different from the produce of Cheshire as if they were manufactured from a different material.

It is this milder species which is a principal article of food of various classes of working people. Gloucestershire has long had a decided superiority in the manufacture of it; but North Wiltshire is now a competitor, and bids fair to take the lead.

Chedder cheese.

The vale of Chedder, in Somersetshire, is thought by many to produce a species of cheese superior in quality to either, and to be therefore the best in England. Its quantity is very limited. It has a spongy appearance, and the *eyes* are filled with a rich limpid oil, not rancid. The true kind is nearly as thick as Cheshire, and they weigh about 30 lb. each.

The county of Durham produces many good cheeses. They are shipped at Stockton, where the cheese factors collect them as well as from Yorkshire, and are distinguished by the names of *new* and *old milk*.

Fanciful cheeses.

Almost all those little cheeses called truckles or loaves, brick-bats, hares, rabbits, pines, dolphins, &c. are made in Wiltshire, and their consumption increases every day. They were once tried on the farms of Harperland and Fairfield in Ayrshire, and succeeded very well: but being more troublesome to make than the common cheeses, and the farmer having no great anxiety to introduce a novelty, they were given up after two years successful experience.

Foreign cheeses. Swiss.

At Neufchatel in Switzerland, a very fine sort of cheese is made, greatly resembling a wash-hand ball: and in the district of Gruyere, a small town in the canton of Fribourg, the famous large cheeses are made which go by that name. Gouda cheese is famous in Holland, and was much esteemed here, while it was to be procured; but during the long interruption of our intercourse with that country was very seldom to be seen. We may now, however, hope to obtain it.

Dutch.

French.

In France, many districts are noted for the excellency of their cheese. "Roqueforte cheese," say the authors of the *Encyclopedie*, "is doubtless the best in Europe. That of Brie, Sassenage, of Marolles, yields in no respect to the best foreign cheese: and that of the mountains of Lorraine, of Franche Compte, and the neighbouring countries, imitates very perfectly the manufacture of Gruyere. Auvergne cheese is as good as the best Dutch."

We have seen and tasted a French cheese which is made with fenugreek, and has exactly the smell of a pig-stye. We know not in what part of the kingdom it is manufactured. "Cheese," says Mr Marshall, "of the first quality, or which comes as near perfection as the nature of it admits, or as art can probably approach, is of a close even contexture; of a firm but unctuous consistency: of a mild flavour while young, acquiring by age an agreeable fragrance. Cheese of this description, like wine of a good vintage, improves by age in mellowness and flavour."

The principal defects of cheese are porousness, hollowness, dryness, partial rottenness, pungency, and rancidness. The two last of which seem, by the experiments of Mr Marshall, to arise from the formation or disengagement of an *essential oil*. Probably the austere flavour of Cheshire cheese depends upon the same cause.

Imperfect state of the art of cheese making.

Though cheese-making has been now practised for more than 4000 years, it is still only in its infancy, and little else than mere empiricism. Two reasons may be assigned for so extraordinary a fact. In the first place, the difficulty of the art itself, arising from the variety of circumstances on which the quality of cheese depends; and in the next place, the manipulations of the process having been hitherto entrusted almost solely to women. We are far from intending by this to throw an imputation on the sex. In the words of Mr Marshall, "they have by a natural cleverness done much;" but having failed, after a long, and, we should think, an ample space allotted them for trial, to bring the art to that perfection of which it is certainly susceptible, they should not reject such aids as are now offered them by others. We express ourselves in this manner, because we have reason to believe that the operations of the dairy-room are considered by some women as a sort of Berecynthian mysteries, on which the uninitiated eyes of the other sex are not permitted to look, and that it requires no little address, and some degree of interest, to be admitted to the knowlege of its rites.

Importance of management.

On the importance of proper management in the process of making cheese, as well as in the making of butter and every other object connected with the dairy, no writer expresses himself more strongly than the intelli-

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gent and experienced Dr Anderson. He is disposed to ascribe to this, at least in a great degree, even the striking difference that exists betwixt Gloucestershire and Cheshire cheese; for the milk, he says, of which these two species are made, differs very little. It is generally supposed that richness, or the proportion of oily matter contained in cheese, is the cause of its agreeable flavour; but Dr Anderson cannot admit this to be the fact; for Parmesan and the small round Dutch cheeses are both deemed by most persons to be of the best flavour, and yet they are made of skimmed milk. Dr Anderson had, in his own house, a small round Dutch cheese made of skimmed milk, which, to the palates of most people who tasted it, appeared, he says, richer and more pleasing than very excellent North Wiltshire cheese. He had likewise seen cheeses made of the same kind of milk with the Suffolk cheeses, "which had nothing of that horny hardness and indigestible quality for which they are remarkable."

Medical qualities of cheese.

As the milk of such animals as live solely on vegetables is of an intermediate quality, betwixt animal and vegetable food, we may infer, that the cheese prepared from this milk will partake of the same nature; and it is understood to constitute the strongest and most nutritive part of the milk. But when separated from the other parts, it is probably less digestible.

Pure cheese, or that which is dry, and has been prepared from skimmed milk, is very indigestible; but that which has had left in it a portion of the oily or butyraceous parts, is understood to be less so, and more nutritious.

Cheese is frequently eaten after having been toasted, by which means it is deprived of a portion of the oily matters it contains, and the other parts are made to adhere more closely together. This food can be digested pretty well by stomachs that are good; but it is certainly improper for the weak, and such as are liable to dyspeptic affections. Probably, however, the small quantities of cheese that are usually eaten at the tables of the rich, have very little effect either one way or other.

Putrefaction.

Cheese is liable to putrefaction; and as this advances, becomes acrid and more stimulant, partly from the evolution of an empyreumatic oil and other substances, and partly from the numerous insects which are generated in it while in this state. It can now scarcely be eaten in such quantity as to be esteemed an aliment, and is only used as a kind of seasoning or relish. It is thought to excite the stomach to the digestion of other food. Ewe cheese digests more easily than that which has been made from cow's milk, but is less nutritious; and goat cheese is more easily digested than either, but is also less nourishing. Physicians advise cheese to be eaten only in small quantities, and quote the following Latin verse:

"*Caseus ille bonus quem dat avara manus.*"

"That cheese is best which is given with a sparing hand." Some of them condemn the use of it altogether, and refer us to the old maxim:

"*Caseus est nequam quia concoquit omnia se quam.*"

A maxim which shews that cheese has been long thought to be a stimulant, assisting in the digestion of other food, whilst it itself remained undigested: an idea, however, which is entirely without foundation. See Thomson's *Chemistry*. Murray's *Chemistry*. Parmentier and Deyeux *Sur le lait*. Marshall's *Rural Economy of Norfolk*. Marshall's *Rural Economy of Gloucestershire*. *Farmer's Magazine*, vol. iv. Anderson's *Agricultural Recreations*. *Papers of the Bath Agricultural Society*. Rudge's *Survey of Gloucestershire*. *Nouveau cours d'Agriculture*. Sir John Sinclair's *Account of the Scotch Systems of Husbandry*. Smith's *Survey of Galloway*. French *Encyclopedie*. Aiton's *Ayrshire*. (*x*)

Dair || Dalecarlia.

DAIS, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 214.

DAL. See DALECARLIA.

DALBERGIA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 279.

DALEA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 279.

DALECARLIA, DALLAND, THALLAND, or DALARNE, is a province in the kingdom of Sweden, which is bounded on the east and north by Norway, Helsingeland, and Gestrickland; and on the south-west and south by Wermeland and Westmannland. It stretches from a little southward of the river Dal, which is somewhat beyond the 60th degree of north latitude, nearly to the 62d degree; and if we suppose it to reach to the Gulf of Bothnia, it extends over five degrees of longitude.

Dalecarlia, as its name imports, has a great variety of hill and dale; and besides several lakes of different sizes, it is watered by two large rivers, and a great number of small streams. The principal rivers are the Dal, the Ljusne, and the Clara. The Dal, which rises among the mountains on the frontiers of Norway, runs through the southern part of the province. It is a slow running river, and is too shallow for the purposes of navigation. From the great and sudden swells to which it is liable, it has been found impracticable to build over it a stone bridge; but as the road to Fahlun crosses it twice, this defect has been ingeniously supplied by a wooden bridge of a very singular construction. A large stage formed of huge square trees, floats so that the upper part is just on a level with the surface of the river, and they are so connected with the banks that they cannot be carried away by the stream. A close row of square trees, about 12 feet long and 9 inches thick, and lying in the direction of the river, is fixed on the middle of the stage, and forms a floating bridge, across which a man may walk without wetting his feet; when it is loaded with a carriage, it sinks a few inches. It is obvious that this bridge can be crossed with the same facility whether the water be high or low. It is particularly secure, and has a wooden parapet on both sides.

Rivers.

The river Ljusne, which waters the northern part of the province, is nearly as large as the Dal, and has its origin in the same mountainous tract. The Clara has its origin among the same mountains, and after running south through Wermeland, discharges itself into the Lake Wenner.

General aspect.

The general character of Dalecarlia is that of a mountainous country, excepting the southern part of the province, near the river Dal. The highest mountain is Fjall, in the parishes of Lima and Särna, near Norway, which rises nearly 3000 feet above the level of the sea. It is a part of the great chain called the Doffrine hills. The rest are much smaller, and are in general round-backed knolls, covered with forests of pine. Two subordinate ranges of hills stretch from the great chain already mentioned, at the place where Fjall stands, and cross Sweden in a south-easterly direction, gradually decreasing both in height and size. One of them passes across the north of Dalecarlia, which it separates from Herjeodal, Helsingland, and Gestrickland. The other, which is the most southern, after running between Wermeland and Dalecarlia, takes a southerly

Mountains.

Dalecarlia.

course, crossing Nerike and part of West Gothland, and ending at the northern part of the Lake Wetter. The principal lake in Dalecarlia is Siljar, Sillian, or Sion, which is seven Swedish miles long, and about a quarter of a mile broad. The river Dal runs through this lake.

Agriculture.

According to Mr Marshall, the country in the neighbourhood of Hedmora, a considerable commercial town, is almost completely barren. The peasants cultivate and inclose small fields round their cottages, merely for the subsistence of their families. The soil is not hard, and a single ox or cow is sufficient to draw the plough. A very small quantity of wheat is reared, the principal productions being oats, barley, and beans. Their cattle are small, but strong. In the neighbourhood of Grodoeu, they often sow and reap in seven weeks, and Mr Marshall informs us that he has seen fields as beautiful as those in England. The proprietors of the forests have established agents, who employ the peasants in cutting down the wood, for the purpose of making pitch, turpentine, and charcoal; and though they are good workmen, yet they earn only about nine sols Tournois, which, with the produce of their farms, is sufficient to support them. In the vicinity of Lynna, agriculture is in a more advanced state. There are some farms that consist of about 70 English acres, and even some that contain 300.

Mines.

Dalecarlia is celebrated for its rich mines. The famous copper mines of FAHLUN will be fully described under that article. About a quarter of a mile from the town of Sather, upon the lake of Linster, is the copper mine of Boisberg. In the same part of the country is the silver mine of Silfwerberg, which was formerly celebrated; but the pits, which are very large, are now filled with water. It was worked with great success in the reign of Queen Margaret, who granted it several privileges. The ore in the eastern part of the mine contains from 28 to 30 grains of gold for every pound of silver.

Eldfal, which is celebrated for its porphyry mines, is situated on the north of the Lake Siljar, and a little to the east of the river Dal. Huge blocks of porphyry are raised, and afterward hewn and polished on the spot, and many of the finest ornaments of Stockholm are formed of it. It is also manufactured into candlesticks, vases, paint-boxes, and other utensils, which are sold in the metropolis. This manufactory, which is under the care of Mr Hjelm, is the most complete in Sweden.

For a full account of the mineralogy of Dalecarlia, we are under particular obligation to Dr Thomson, who lately (1812) visited and examined that province. The following description of the province, which we have copied literally from Dr Thomson's *Travels*, as it is unsusceptible of abridgment, is principally taken from Hisinger's *Mineral Geography of Sweden*.

Mineralogy.

"In the south aud south-east part of the province, in the parishes of Rättoiks, Mora, Venjans, and Malungo, the rocks consist of the same species which are found in other parts of Sweden at a similar height; namely, red and grey granite, (gneiss) mica slate, primitive limestone, and sometimes, though rarely, primitive trap. In the north and north-west portions of the same parishes, we find these covered by beds of rocks, which belong chiefly to the transition class. These consist of gravel, conglomerate, hard flinty alpine sandstone, over which for a considerable extent lie hälleflinta* and jasper porphyry, transition greenstone, greenstone porphyry, porphyry breccia, and transition clay slate; all lying in beds, which approach more or less to the horizontal position. A conglomerate, consisting of sandstone breccia, and breccia saxosa, lies over this alpine chain of rocks in the Svackufjäll, Elgshoghan, Salfjäll, Mossevola, &c. which lie partly in Sweden and partly in Norway. Farther down, in the parish of Särn, is found alpine sandstone. Over this, in the parish of Elfvedal, within the division of eastern Dalelf, there is an extensive tract of transition porphyry, porphyry breccia, and transition greenstone, which continues over a part of the parishes of Mora and Orssa. Round western Dalelf, in the parish of Lima, are found alpine sandstone, clay slate, trap, and trap porphyry, all belonging to the transition rocks.

In the parishes of Rättvik, Ore, Orssa, Mora, and Sophia Magdalena, there occur beds of transition rocks, consisting of sandstone, limestone, clay slate, and marl slate, interspersed with petrifactions, and of posterior formation to the preceding rocks, which they in part cover. Respecting this tract, the following observations may be made.

1. The aspect of the surface is usually uneven, some few plains excepted, as for example, the sandy plain between Rättvik and Boda chapel; that between Dalby and Furndal, in the parish of Ore; the plain of Skatunge, and the north part of Solleröns. The beds of limestone at Vika and Vomhus, in the parish of Mora, are likewise disposed into plains. Finally the surface is broken into alternate heights and vallies, the beds of which either constitute oblong or level ridges, as those about Boda and Osmundsberg; or they fill up hollows and precipices consisting of older rocks, the flanks of which, to a greater or smaller extent, consist of these beds. This is the case at Digerberg, in Orssa by Skatunge chapel, and at a height between Vikarby and the church of Rättvik, &c.

The heights round the lakes of Siljar and Orssa are very low: at Vomhus, Vika, Omon, near Sollerön, and at the foot of Digerberg, they lie almost on a level with the surface of the water, and probably constitute the bottom of the lake Orssa. On the other hand, at Glekärna in Rättvik, they occur, according to Cronstedt, nearly 200 fathoms above the surface of the lake Siljar, and at Osmundsberg they are still higher.

The boundaries and circumferences of the different beds can hardly be ascertained with accuracy, on account of the forests and alluvial earth with which they are covered. That part of the lake Siljar which is called Rättvik is surrounded with beds of limestone, which lie over rocks of granite and mica slate, from Osbäck, five-eighths of a Swedish mile south from Rättvik church, to Ick-on in the same parish. From Rättvik these beds are continued in a north-easterly direction to Boda chapel, and they may be seen still farther north in the parish of Ore. They are found likewise in Rättvik near Beäckby, Alsorby, Kyrkan, Vikarby, Oiga, Ostbjörka, and the village of Gliskärna.

Beds of limestone are found likewise in the parish of Mora, by Vomelf and Vomhus chapel, and near the village of Vika and Selbäcks. The beds found at Vika are a continuation of those at Sollerön.

Sollerön parish and that of Sophia Magdalena consist for the most part of a flat round height of red granite

* This word, used by Cronstedt, is applied in Sweden to quartz, hornstone, and compact felspar. The porphyry alluded to is felspar and clay porphyry.

Dalecarlia. Mineralogy.

(gneiss), which towards the north and north-west sinks into a level plain. Over the lower side of this height passes transversely a bed of limestone, and a little to the north of it at Utanmyra sandstone occurs.

The curvilinear extent of this bed from Rättvik near Boda, Ore, Skaturgby, and Orssa, to Vattnas in Mora, amounts to about 46⅔ English miles. Its breadth may be estimated at about 6⅔ English miles; but this breadth varies considerably in different places.

2. Sandstone and limestone, which sometimes contains posterior beds of clay slate and marl slate, intermixed and composed of the substances that have been named in the preceding table of the transition rocks.

The sandstone in this tract, as is the case with the same rock in other parts of the kingdom, constitutes always the lowest bed. Beds of it with limestone are seen at Sollerön, near the grindstone quarry in Orssa, a quarter of a mile (1⅓ English mile) from Dalby in Ore, and in a variety of other places. These beds dip to the north-north-west and north, at an angle of between 30 and 40 degrees; while the limestone dips to the west at an angle of about 49 degrees. At Styggforss in Boda, the sandstone beds lie immediately over the primitive rocks, and are accompanied by marl slate and limestone. At Sollerön, and by Vikarby, limestone beds are found lying immediately over granite.

Limestone, with intermingled beds of clay slate and marl slate, constitute the uppermost bed. The clay slate and marl slate are found only in the upright beds, surrounded by the common limestone, to which the strata are parallel, though the beds are not particularly level. Examples of this may be seen on the north-west side of the cliff of Osmundsberg, at Styggforss, at Skatungbyn, in the enclosure near the river Ore, where layers of thin slaty clay slate, running east and west, and dipping at an angle of 23 degrees to the north, are surrounded with parallel beds of limestone. By Vikarby in Rättvik, the whole height upon which the village is situated, rising gradually from Siljar, consists of beds of limestone running in an east-north-east and west-south-west direction, and dipping at an angle of 25 degrees towards the north-north-west. Near a windmill in the same place occurs a bed of grey clay slate, 22 feet thick, running in the same direction, and dipping at a similar angle with the surrounding limestone.

The rocks that lie over these beds are dissimilar both in age and materials. North-east from Siljar, Orssa lake, and Ore river, the covering rocks consist of transition porphyry and trap. About the eighth part of a Swedish mile from the limestone beds, south from the village of Vongsgjärd, on the road to Mora, at the foot of the Digerberg, there is a red conglomerate of quartz and jasper, and beside it a rock composed of quartz and hälleflinta. Farther down about one-eighth of a Swedish mile nearer the north in Mora, there is a compound rock, consisting of blackish brown heavy greenstone and yellowish, reddish, and greenish quartz, with cornelian red lines and streaks; but, in consequence of a multitude of rents and cracks, so brittle that it falls to pieces upon the smallest blow.

3. The position of the beds is very various. One half of them retain their primitive position, and are either horizontal, or elevated a few degrees by the primitive rocks on which they lie. Others are raised almost to a perpendicular position. At Utanmyra near Sollerön lie sandstone beds nearly in a horizontal position. The same thing occurs at the whetstone quarries between Kalmora and Nederberga. Horizontal beds of limestone are found at Vombus, Vika, Sollerön, Farndal, and Dalby. At Grano they dip north-north-west and north, at an angle of about 10 degrees. On the contrary, there occurs a whole tract of limestone, the beds of which are either perpendicular, or incline at an angle at least greater than 40 degrees. This tract is situated between Boda chapel and the hill of Osmund.

The hill of Osmund, half a Swedish mile from Boda, constitutes the highest point of the whole tract. The summit of it is 40 fathoms above the surface of the nearest lake. This hill is composed of the following beds: immediately under the soil, loose brown clay slate (slate clay), 12 feet—coarse grey fuller's earth, 4 feet—dark grey fine clay slate (slate clay), 1 foot—brown limestone, 1½ foot—loose brown clay slate (slate clay), ½ foot—greyish brown limestone, 1½ foot—loose clay slate (slate clay), decrepitating in the fire—compact brown limestone, 1 foot—loose brown clay slate (slate clay), with balls of limestone from an inch to a foot in length, and containing a great deal of petroleum, 2 feet—bituminous limestone, ½ foot—brown clay slate (slate clay), ½ foot—blue clay, containing some silver, 1 inch—below all these comes the common primitive limestone of the country.

4. The sandstone is composed of fine siliceous matter mixed with oxide of iron and clay, and often contains some lime. The varieties of it are as follows:

Light grey fine grained sandstone, varying in colour from white to dark grey, and differing in hardness. Found at Kallmora, Styggforss, Sollerön.

Light grey sandstone, with streaks of red iron shot clay. Kallmora.

Pale red fine grained sandstone, lighter and darker coloured. Kallmora, Galleros.

Pale red fine grained sandstone, with round white spots. Styggforss, Karfsos.

The limestone exhibits the following varieties.

Compact limestone, sometimes grey, sometimes reddish brown, in distinct beds; the former with green spots, the latter with green and yellow veins.

Limestone, with a splintery fracture, translucent, reddish, yellow, and white, with cavities filled with calcareous spar, stalactites, and petroleum. At Dalby lime quarry.

Grey and reddish limestone, mixed with sand. The hill near Rättvik's church.

Red and white lumachella with small white anomiæ and entrochi, in reddish brown limestone. At Karfsos.

Calcareous spar. At Gliskärna, Forndal, &c.

Grey and red marl slate. At Styggforss."

Inhabitants.

The inhabitants of Dalecarlia differ very much from the rest of the Swedes, both in appearance and manners, and, like the Scotch Highlanders, whom they in many respects resemble, they have always been celebrated for their integrity and courage. The porters and labourers in Stockholm are from this province, and wherever they go, they retain the original dress of their country. The men wear long coarse coats of a whitish grey colour, with buttons of horn or leather. They use a leather girdle; and their hats are like those of the Quakers of this island. Their military character stands very high, and their bravery has frequently saved Sweden. The Dalecarlian regiment enjoys the same reputation in the Swedish army as the 42d does in ours.

Language.

The language of the Dalecarlians is supposed to resemble that which is spoken in the Lowlands of Scotland; and Dr Thomson mentions, that a Dalecarlian who landed at Aberdeen was understood by the people of that town. Professor Eubergius states, that the Dalecarlian tongue is so like the Icelandic, that when the latter is

Dalechampia || Dalkeith.

pronounced in the Dalecarlian accent, it is mistaken for the Dalecarlian.

Population.

According to Peuchet, the population of this province is about 120,000. The principal towns are Fahlun, Hedmora, and Satta; and the chief villages are Lecksand, Mora, Rattwik, and Funa. Each of these parishes is supposed to contain about 9000 inhabitants. See Thomson's *Travels in Sweden during the Autumn of* 1812, chap. vi.; Coxe's *Travels*, vol. v.; and *Promenade d'un François en Swede par de la Tocnage*, 1801. (*j*)

DALECHAMPIA, a genus of plants of the class Monœcia, and order Monadelphia.

DALEBORDIA, a genus of plants of the class Icosandria, and order Polygamia. See BOTANY, p. 233.

DALKEITH, from a Gaelic word which signifies a plain between two rivers, is a town of Scotland in the county of Mid-Lothian. It is beautifully situated on a pretty high ridge of ground between the two rivers called the North and South Esk, but nearest the North Esk, from which the ridge has a rapid ascent. The principal street, which is straight and broad, stretches from east to west. At its eastern extremity is the gate which conducts to Dalkeith House, the principal seat of the Duke of Buccleugh, and nearly at its other extremity a street branches off to the South Esk, and another to the North Esk, both of which rivers are crossed by good stone bridges. The church and the jail, which are not remarkable as public buildings, stand in the principal street. Several manufactures have been established in this town, which are carried on with great activity. The following are the principal. A hat manufactory, which gives employment to about 12 men and as many women. Mr Hislop, to whom it belongs, has likewise a manufactory near Manchester, for the purpose of making coarse hats, a branch of the trade which can only be carried on with advantage in that part of the country. At the iron foundery under Mr Mushet, all sorts of cast iron goods and smith work are manufactured. The pig iron is brought from Omoa, Calder, and Shotts iron works, at the rate of twenty-one shillings per ton of land carriage. There is also at Dalkeith a tannery, a soap-work, and candle manufactories. Dalkeith is principally celebrated for its corn market, which is held every Thursday, and which is one of the largest in Scotland. A charity school on Dr Bell's plan was established in 1813, by the Duke of Buccleugh, who is at the sole expence of paying the teacher. It already contains 70 boys.

Dalkeith House, which is situated a little to the east of the town, is a large building, with wings projecting in front, and is erected on the site of the old castle of Dalkeith. The grounds, which are exceedingly beautiful by nature, and laid out with great taste and judgment, occupy the tongue of land formed by the North and South Esk, which unite about half a mile below the house. A great number of fine oaks, and trees of all kinds, adorn the park. The North Esk is crossed by a handsome stone bridge of one arch, seventy feet wide and forty-five high; and the banks of both the rivers are cut into extensive walks. The noble possessors of this princely estate have been long distinguished for all the virtues which give to rank and fortune their truest splendour. The discrimination with which their benevolence is directed, and the delicacy with which it is proferred, could not easily be concealed; but the extent of their charities will probably never be known, but to the numerous individuals of almost all ranks in society whom they have relieved and rendered happy. It is not the province of a work like this to record acts of private beneficence, however noble and affecting; but virtue sometimes appears in such a form as to command our admiration; and while our pages are constantly filled with the praise of talents and genius, we could not refuse a tribute of admiration to a system of benevolence, unexampled and almost unlimited.

Dalmatia.

About a quarter of a mile from Dalkeith, on the South bank of the South Esk, stands Newbottle House, the seat of the Earl of Ancrum.

Population of the parish of Dalkeith in 1811, 4709; number of houses 534, number of families 1131. (*w*)

Boundaries.

DALMATIA, a country in Europe, bounded by Servia on the east, Croatia on the west, Bosnia on the north, and the Gulf of Venice, or Adriatic Sea, on the south. Including the isles which lie along its coasts, it extends from 12° 10′ to 16° 40′ of longitude, and from 42° 25′ to 45° 35′ of latitude. Subject, however, to many irregularities in its outline, it does not contain such an extent of surface as this measurement appears to give. It derives its name from its ancient capital Delminium, and formed a part of ancient Illyricum, or Illyris. The other part was Liburnia; but both are now included under the common name of Dalmatia, though the Austrian government has, in modern times, thought proper to revive and employ the ancient name Illyria. This country has undergone a great variety of revolutions, of which, however, the limits of this article do not admit of any detailed account. Under all the changes of dominion to which it has been successively subjected, it does not seem to have received any improvement; for, though possessed of many advantages, it is still very far behind in every thing almost by which a country rises to eminence and respectability. Its last masters were the French, who have now (1814) retired from its territory, and abandoned it to the Austrians, Russians, or Turks, as they may happen to think their rights or their interests involved.

Dalmatia has a great deal of elevated, rugged, and barren ground, and abounds in scenery, which, for magnificence and sublimity, can scarcely be surpassed. There are also many parts of it vallies equally beautiful and fertile, tolerably well cultivated, and covered with flocks of sheep and cattle. Some of its rivers are navigable for a considerable way. The whole coast is deeply indented with creeks and bays, and bordered with a great number of islands.

Agriculture, &c.

The cultivation, upon the whole, is extremely bad, both on the continent and on the islands. The people are destitute of skill, enterprise, and stimulus. Indeed they are mostly in a barbarous or piratical state; and though they were capable of improving the country, and raising from it all that it could produce, still the insecurity which hangs over the fruits of their exertions, would prevent them from making any steady and persevering efforts. The proprietor is the slave of his tenants: what they pay in rent, is rather given to him as an alms, than demanded by him as a right; when he complains, they threaten him with their vengeance, and sometimes oblige him to supplicate them to spare his life. They are so rude, and have so many ways of escaping, that he has no hold of them, and is entirely at their mercy. Agriculture of course is much neglected, even where it might be carried on in the easiest way, and with the greatest success; and, instead of having abundance of wholesome food, the people are sometimes under the necessity of subsisting for several months of the year on wild roots. The cattle are numerous enough, but extremely small; so that, as they are employed in labouring the fields, and as the plough

Dalmatia.

must be accommodated to their strength, the ground is very superficially wrought. There are sheep to furnish the inhabitants with wool; but its quality is not good. The best is found at Bossiglina, in the district of Trau. Dalmatia produces maize, wheat, pulse, grapes, olives, figs, almonds, and various other kinds of fruit. There are no potatoes. Two sorts of manna also might be procured, one from the ash tree by incision, and the other from a species of grass; but the inhabitants know not how to appreciate such sources of subsistence and wealth. The shell fish found here are remarkable neither for variety nor beauty. Most of the mills in Dalmatia have their wheels placed horizontally, and their spokes terminating in a kind of spoon. At Zara, they manufacture the liquor called marasquin, so much celebrated in most of the cities of Europe. It is made of marasques, a species of cherry. The stone of the fruit gives the liquor its peculiar flavour. In the county of Trau, the vine and olive tree are cultivated to a great extent, and in great perfection; so that from that small district alone, there are produced annually 13,000 barrels of excellent oil, and 50,000 hogsheads of remarkably good wine. It furnishes also 300,000 lb. of dried figs, a great quantity of almonds, 400,000 lb. of cheese, and wool in proportion. The inhabitants of Morter make a kind of coarse cloth from the threads of the broom, which they are very industrious in gathering. This cloth, however, is too coarse for apparel, and is only employed for making sacks, and packing up merchandise. In all the islands, fishing is a general avocation. The fish is salted and sold, which brings to those who are engaged in the employment a very considerable revenue. The fishing, however, is neither applied to with that eagerness, nor carried on with that judgment, which are necessary to success. It was once in a flourishing state, but has latterly declined very much. In the lakes and rivers there is abundance of salmon, trout, eels, &c. The sea fish are mackarel, pilchards, mullets, congers, gold-fish, tunnies, &c. There are also dolphins and porpoises.

Rivers.

Cettina.

The principal rivers of Dalmatia, are the Cettina, the Kerka, and the Narenta. The *Cettina*, which is the Titurus of the ancients, takes its rise at the village of Zarebiza. In the opinion of M. Busching, the Abbe Fortis, and others, the four springs which constitute its sources, are ramifications of a subterraneous river. Of this, there are several presumptive proofs; the most important of which is, that in one of the springs, which is remarkably deep, excellent trout of a considerable size are caught. These, it is alleged, could only get there on the supposition that is alluded to. It is a curious fact, that, according to the observation of the country people, the sources of the Cettina rise and fall in regular proportion to the rise and fall of the Lake Buscoblato, which is situated at a distance of twenty miles, and separated by very high mountains. This circumstance has led them to conclude, that there is a direct communication between the two. The course of the Cettina is wild and romantic. It seldom runs through a plain of any length, but for leagues together dashes from rock to rock between perpendicular mountains, where it seems to have cut a passage for itself from the very surface to the very bowels of the earth. Near the fort of Duaro, it forms a very grand cascade. Its breadth is about seventy feet, and it falls vertically from an elevation of a hundred and fifty, amidst vast rocks irregularly piled upon one another, unrelieved by one vestige of vegetation, and inhabited only by screaming vultures of an enormous size. Having escaped from this horrid cataract, it pursues its way for about a quarter of a league, when it arrives at a precipice twenty feet in height, and forms another cascade. Here, however, the scene changes,—verdure and trees and flowers appear in all their beauty, the mountains decline into wooded hills, and these again into plains and meadows, through which the Cettina flows slowly and majestically, till it falls into the sea not far from the dismantled fortress of Vissach.

Kerka.

The *Kerka* was called Tatius by the ancients, and formerly separated Liburnia from Dalmatia. It originates in a grotto at the foot of the mountain Topoli—runs in a south-west direction—traverses the lake of Scardona, which is distant from its source about thirty miles—and, issuing from thence, proceeds a few miles farther on, to form a lake about two leagues in length, and empties itself into the sea through the narrow strait of St Antonio. On this river there are several very fine cascades. The most celebrated are those at Rochislap and Scardona. At Rochislap the river is of considerable width. A bridge, after the Turkish fashion, has been thrown over it, consisting of no fewer than sixty arches. And this, together with some mills, several cottages, and islands covered with trees, render the scene beautiful, independently of the fall of water, which itself is not very great, being only five-and-twenty or thirty feet, but is rendered beautiful by its being divided into twenty separate rivulets, some of which tumble rudely over the rocky precipices, while others pour gently through chasms, which have been gradually formed and polished by the friction of the currents. The cataract at Scardona is far more magnificent. It is not quite so large, but fully as grand and striking, as the falls of Niagara. M. Cassas gives a fine description of it: "At the foot," says he, "of the first three shelves, or steps, where the river divides, the united summits of a few trees, whose trunks are concealed by a variety of objects in the fore ground, intersect with a verdant line the whole width of the cascade; but as the water approaches it becomes still wider. A semicircular terrace, prolonging its colossal propulsion over the abyss which receives it, thus curbs its velocity. The immense body of water fills the noble contour of this long and heavy terrace. The land seems to tremble from a distance by the weight of its fall; the air, on being displaced by the water, seems at first to hiss or sigh; which sound at length increases, till the noise is so terrific that the ear is not able to sustain it; nor can the eye at last comprise the extent of the view, or the mind sufficiently admire the awful appearance of the whole." On approaching nearer, "all is changed, and nothing prevails but confusion, chaos, or the most horrid distraction. There are then no longer to be seen that uniformity of masses, that beauty in the groupes, that majesty in the combination; but we behold innumerable rocks, broken, steep, and dispersed, presenting frightful points, which appear to be rising from behind the water and the trees. It is no longer a river, but an ocean, roaring and rushing with fury against the shapeless masses which obstruct its course."

Narenta.

The *Narenta* is in the eastern district of Dalmatia; it rises from the swampy lake of Mostar, and after running a pretty long course, and receiving several tributary streams, empties itself by three mouths into a gulf of the same name. This river is large, but does not admit of navigation far up by any boats, but those of a small size. Its waters are brackish above twelve miles from the sea. The tide flows considerably farther. It abounds in a variety of excellent fish. The plain through which the lower part of it flows is of a rich and pro-

Dalmatia. ductive soil, but by no means in a proper state of culture. Besides the large rivers now described, there are many more of considerable size, on whose banks there is a great deal of beautiful and romantic scenery. There are also several lakes of large extent, and well stored with fish. The principal of these are Vrana, Scardona, Sebenico, Rastoc, Saschero, Desna, Sablachia, and Morino.

Towns. The principal towns of Dalmatia are Zara, Spalatro, Sebenico, and Salona. Of these places, which are on several accounts worthy of notice, some description will be given afterwards. It is remarkable, that so few of the multitude of towns which formerly existed in this country are now to be seen. Not only are their walls and monuments destroyed, but they are absolutely depopulated. This unusual fact is probably to be traced to the contests carried on by the Venetians and Turks; the former of whom were too feeble to protect their conquests, and the latter at too great a distance to retain them. In consequence of this, nothing but plunder, devastation, and carnage, followed in the train of those wars in which these two powers so long contended for the dominion of Dalmatia.

Minerals. Dalmatia abounds in marble. It is to be found both white and variegated. Generally it contains the remains of vegetable and marine productions; and sometimes it is pervaded by matter of volcanic origin. Its quality is various; some of it beautiful and excellent, but a great proportion of it false or dull in the colours, full of gravelly particles, harsh therefore under the chissel, and not susceptible of a fine polish. There are masses of gypsum near Scign, and in other places. That which is found near Scign is of a finer quality than that taken from Ancona, which is used at Venice. Many parts of the country indicate the existence of volcanoes at a remote period. This is the case particularly at Krin, which is situated in the course of the Cettina, and at Knin, which lies near the source of the Kerka. Marle of the most perfect whiteness is met with in the district of Zara. In the grottos from which the Cettina takes its rise, there is a great quantity of stalactites; and petrifactions of various kinds abound throughout the whole country. There is a mine of ironstone not far from Scign; and mines of the same substance are also found in the territory of Knin. In ancient times this country produced a vast quantity of gold. Pliny relates that in the time of Nero it furnished fifty pounds of gold per day; and Martial gives it the appellation of *terra aurifera*. Now, however, this metal is never met with; neither is there any proof of mines of silver and mercury, though that is the common opinion and report among the inhabitants. In the island of Bua there is an extensive mine of asphaltes.

Antiquities. Dalmatia is a rich, entertaining, and instructive field for the antiquarian. Of the many objects which deserve his attention, are the triumphal arch at Pola, called Porta Aurea; the amphitheatre and temple at the same place; the palace of Dioclesian, &c. at Spalatro; the walls of Asseria or Podgrage; and the ruins of Salona.

Islands. The islands on the coast of Dalmatia are extremely numerous: *Lissa*, which is about thirty miles in circumference, and has a temperate climate, some fertile vallies, and a good fishing coast; *Pelagosa*, which is composed of lava, is subject to frequent earthquakes, and has all the appearance of being recently produced by a volcano; *Lesina*, which is 44 miles long, and 8 at its greatest breadth, rocky and sterile in the heights, but covered with corn and fruit trees on its coasts, and better peopled than any other of the Dalmatian isles; *Brazza*, which is 32 miles in length, and not more than 9 in breadth, is rough and mountainous, produces wine, however, and cattle, but is liable to be parched; *Ulbo* and *Selva*, which are well inhabited, have plenty of cattle, but want good water, and produce little corn; *Uglian*, which would be productive if the inhabitants had sufficient skill, and if, like almost all the other islands in that quarter, it were not deficient in water; *Arba*, which is 30 miles in circumference, contains about 3000 inhabitants, and produces sheep, grapes, olives, and some corn; *Zuri*, &c. &c.

Inhabitants. The people of Dalmatia may be divided into three classes: those who reside in the towns on the coast; those who live wild on the mountains; and those who inhabit partly the mountains and partly the vallies. The first class are properly *Italians*. They have all the characteristics of that people. They speak the same language. Their religion, manners, and customs, are the same. They are distinguished by the same habitual politeness, the same innate servility, the same irresoluteness and timidity, the same want of every thing great and patriotic, the same love of intrigue, duplicity, cabal, and superstition. In short, they exhibit all those features of littleness and degradation, which usually mark a people, who, though originally virtuous and mighty, have first become enervated by corruption, and then being subdued by foreign powers, have added all the evils of national slavery to those of luxury and licentiousness. They are just what we have been taught to consider the Romans in the last period of their degeneracy.

Italians.

Haiducks. The second class consists of a small but growing number of miserable beings denominated *Haiducks*. These are not to be regarded as a distinct nation, according to the opinion of some writers. The word *haiduck* signifies originally the chief of a party or a family. In Dalmatia, it is employed to designate a criminal, fugitive, assassin, or highway robber; and, in fact, the Haiducks are of this very description. They live like wild beasts in the caves and forests of the mountains, exposed to all the rigours of the seasons; wandering amidst precipices that are almost inaccessible; clambering from rock to rock, that they may discover their prey at a distance; carrying off oxen and sheep, to feast upon their flesh, and make shoes of their skins; breaking into shepherd's huts, and taking by force whatever they need; and sometimes so urged by hunger and necessity, that a party of four will not only attack, but overcome and pillage a caravan of fifteen or twenty Turks. Against the Turks they have a native inveterate hostility, which they take every opportunity of gratifying. Religious zeal, inflamed by the language of their ecclesiastics, increases the hatred which, from various other causes, they bear against that people. A Haiduck thinks himself a man of great consequence, when he has succeeded in shedding the blood of an Infidel. The Haiducks, savage as they are, have some of those traits of generosity which are generally found among tribes in the same stage of society. Travellers are liable to be attacked and plundered by them; but they are faithful to every traveller who has the prudence and the courage to put himself under their protection, and trust to their fidelity. In this case they are never known to deceive. It is surprising, that the Haiducks are so forbearing to the people in the maritime parts of the country, whom they look on as the author of all their calamities and misfortunes. Another shade of ferocity added to their character, an augmentation of their numbers, which is likely enough to take place, and the appearance of some able and enterprising chief among them, might render them extremely formidable to the more inhabited and civilised parts of Dalmatia.

Morlachians. The third class of inhabitants are the *Morlachians*. According to Abbe Fortis, the name is derived from two words, *more*, sea, and *ulah*, black, and indicates, that they originally came from the Black Sea. One thing is evident, that their language, dress, customs, and character, demonstrate them to have had a different origin from the inhabitants of the maritime districts of the country. Among themselves, the Morlachians have several diversities, which seem to prove either that they were not of the same race from the beginning, or that some extraordinary revolutions have happened among them since they settled in Dalmatia. The Morlachians of the vallies of Kotar, and of the plains of Scign and Knin, are generally of a fair complexion, with blue eyes, broad face, and flat noses, and in character they are mild, honest, and docile. But the Morlachians of Douaré and of Vergoraz, a mountainous and sterile district, have an olive complexion, long countenance, and slender form; and are fierce, proud, bold, and enterprising. The Morlachians, who live at a distance from the sea and the garrison towns, are distinguished by probity and sincerity. These qualities lead them to put a degree of confidence in the goodness of others, which degenerates sometimes into good nature and simplicity. The Italians, by their tricks and impositions, have done a great deal to make them shy and suspicious, though they still show generosity and hospitality to strangers,—virtues which are practised alike by the poor and the rich. They are very punctual in fulfilling their engagements, and paying their debts. Ignorant of domestic economy, they resemble the Hottentots in some respects, and will often devour in a week as much provision as would serve them for many months. Their friendships are very durable. Indeed these are formed by religious ceremonies. In the Slavonian ritual, there is a formula for giving a public and solemn benediction to the union of two friends. This practice is not so prevalent as it was formerly. Equally strong and lasting are their resentments. A Morlachian will requite a favour, but he knows nothing about forgiving an injury. The Morlachians are naturally lively and ingenious; but the disadvantages of their situation have prevented them from making any considerable progress even in the most useful and necessary arts. With respect to religion, they are extremely superstitious, and believe firmly in ghosts, witchcraft, and enchantments. They belong partly to the Greek and partly to the Romish church. The two communions have an inveterate hatred at each other; and with regard to all ecclesiastical matters, are equally in a most wretched state. The manners of the Morlachians are simple. The female sex is treated with much contempt, and often with cruelty, especially after marriage. Their ordinary food is milk, prepared in every different way; and sometimes the flour of barley, wheat, &c. made into a sort of thin cakes. The cottages which they live in are mean, smoky, and ill furnished; and very rarely is a tolerably good house to be seen even in possession of the wealthy. They sleep on the ground wrapt in a large thick cloak. Their dress is simple and economical. When they go from home, they always carry a fusee over their shoulder. And when completely armed, they also take one or two pistols, and an enormous knife. They are much given to dancing, poetry, and music. The Abbe Fortis has given a specimen of their poetry in a funeral song, which has a great deal of simplicity and tenderness. See the *Travels of L. F. Cassas in Istria and Dalmatia*, by Jos. Lavallée; and *Voyage en Dalmatie*, par M. L'Abbé Fortis, trad. de l'Italien. (τ)

DAMASCUS, a celebrated city of Asia, and anciently the capital of Syria, may be accounted one of the most venerable places in the world for its antiquity. Origin. It is supposed to have been founded by Uz, the son of Aram; and is, at least, known to have subsisted in the time of Abraham. (Gen. xv. 2.) It was the residence of the Syrian kings, during the space of three centuries; and experienced a number of vicissitudes in every period of its history. History. Its sovereign, Hadad, whom Josephus calls the first of its kings, was conquered by David king of Israel. In the reign of Ahaz, it was taken by Tiglathpileser, who slew its last king Rezin, and added its provinces to the Assyrian empire. It was taken and plundered also by Sennacherib, Nebuchadnezzar, the generals of Alexander the Great, Judas Maccabeus, and at length by the Romans in the war conducted by Pompey against Tigranes, in the year before Christ 65. During the time of the Emperors it was one of their principal arsenals in Asia, and is celebrated by the Emperor Julian as, even in his day, "the eye of the whole East." About the year 634, it was taken by the Saracen princes, who made it the place of their residence, till Bagdad was prepared for their reception; and, after suffering a variety of revolutions, it was taken and destroyed by Tamerlane, A. D. 1400. It was repaired by the Mamelukes, when they gained possession of Syria; but was wrested from them by the Turks in 1506; and since that period, has formed the capital of one of their pashalics. Situation. The modern city, called Damas, Domeschk, Scham Sherif, is delightfully situated, about 50 miles from the sea, in a fertile and extensive plain, watered by a river which the Greeks called Chrysorrhoas, or golden river, but which is now known by the name of Barrady, and of which the ancient Abana and Pharphar are supposed to have been branches. Description. The city is nearly two miles in length from its north-east to its north-west extremity, but of very inconsiderable breadth, especially near the middle of its extent, where its width is much contracted. It is surrounded by a circular wall, which is strong though not lofty; but its suburbs are extensive and irregular. Its streets are narrow, and one of them called Straight, mentioned in Acts, ix. 11. still runs through the city about half a mile in length. The houses, especially those which front the streets, are very indifferently built, chiefly of mud formed into the shape of bricks and dried in the sun; but those towards the gardens, and in the squares, present a more handsome appearance. In these mud walls, however, the gates and doors are often adorned with marble portals, carved and inlaid with great beauty and variety; and the inside of the habitation, which is generally a large square court, is ornamented with fragrant trees and marble fountains, and surrounded with splendid apartments, furnished and painted in the highest style of luxury. The market places are well constructed, and adorned with a rich colonnade of variegated marble. Public buildings. The principal public buildings are: the castle, which is about 340 paces in length; the hospital, a charitable establishment for the reception of strangers, composing a large quadrangle, lined with a colonnade, and roofed in small domes covered with lead; and the mosque, the entrance of which is supported by four large columns of red granite, the apartments are numerous and magnificent, and the top is covered with a cupola ornamented with two minarets. There is shewn

Damascus. also the church of John the Baptist, now converted into a mosque; the house of Ananias, which is a small cellar or grotto; the house of Judas, with whom Paul lodged; the gate, where the apostle was let down in a basket; and, about half a mile beyond the east gate, the scene of his vision, which is marked only by a heap of gravel.

Population. The city is divided into 23 districts, each under a separate magistrate. The number of inhabitants is estimated by Volney at 80,000, by Browne at 200,000, and by others at 180,000. Of these, about 15,000 are Christians, and the greater part of the remainder Arabs and Turks. The people are generally described by the inhabitants of the surrounding countries as peculiarly mischievous and wicked. They are particularly intolerant towards Christians; and it is scarcely possible to appear in the streets in an European dress. But Dr Browne observes, that their pride in this respect is considerably abated, and that he found little difference between them and other Oriental citizens.

Trade. Damascus is the centre of the commerce of Syria; and its trade is rendered still more considerable, by its forming the rendezvous to all the pilgrims from the north of Asia to Mecca. Their number amounts every year to thirty or forty thousand; and many of them arrive in Damascus several months before the departure of the caravan. The city then presents the appearance of an immense fair, and every place is full of camels, horses, mules, and merchandize. Even in the year 1432, Brocquiere describes this assemblage of traders and devotees as remarkably numerous. "On the morrow of my arrival, I saw the caravan return from Mecca. It was said to be composed of three thousand camels; and in fact it was two days and as many nights before they had all entered the town." Caravans proceed from Damascus also to Bagdad and Grand Cairo; and the principal imports by these various channels are broad cloths and the different metals, which come from the coasts of the Mediterranean, and shawls, muslins, and other Indian stuffs, which are brought by the way of Bagdad.

Manufactures. Its own manufactures consist chiefly of silk and cotton fabrics; and of an excellent soap made of olive oil, kale, and chalk. Great quantities also of dried fruits and sweet meats, of their own produce, are exported to Constantinople, to the annual value of £40,000. Damascus was formerly celebrated for the manufacture of sabres, of such superior excellence, that they would bend to the hilt without breaking, while the edge was so keen as to divide the firmest coat of mail, and which are supposed to have been constructed, by a process now lost, of alternate layers of iron and steel. Tamerlane, when he took the city in 1400, is said to have carried into Persia their best artists in steel; but Brocquiere speaks of the inhabitants of Damascus in 1432 as still excelling in these manufactures. "The Damascus blades are the handsomest and best of all Syria; and it is curious to observe their manner of burnishing them. They have for this purpose a small piece of wood, in which is fixed an iron, which they rub up and down the blade, and thus clean off all inequalities, as a plane does to wood; they then temper and polish it. This polish is so highly finished, that, when any one wants to arrange his turban, he uses his sword for a looking-glass." "There are made at Damascus," he adds, "and in the adjoining country, mirrors of steel that magnify objects like burning glasses. I have seen some, that, when exposed to the sun, have reflected the heat so strongly, as to set fire to a plank fifteen or sixteen feet distant."

Gardens. Damascus is surrounded by a fruitful and delightful country, forming a plain nearly 80 miles in circumference; and the lands, most adjacent to the city, are formed into gardens of great extent, which are stored with fruit trees of every description. Besides the mosques and minarets, which are the usual ornaments of Turkish cities, the gardens are filled with pleasure-houses, turrets, and similar structures; a circumstance which altogether gives to the place the appearance of a noble city in the midst of an extensive forest, and fully justifies the appellation commonly given to it by Orientals, of goutah Demesk, orchard of Damascus. The pleasantness and fertility of these grounds are chiefly to be ascribed to the waters of the Barrady, which are distributed by numberless streams and rivulets in such a manner, that every garden has a fine run of water passing through it, at once fertilizing the soil, and supplying a variety of artificial fountains and ornamental water-works. So numerous are the fruit trees in the vicinity of the city, that those which are decayed supply the inhabitants with fire-wood; and, together with the walnut and Lombardy poplar, furnish also the principal materials for building. In these orchards the air is most salubrious, the soil remarkably productive, and the fruits, especially the apricots and grapes, as much distinguished by their superior flavour as by their extraordinary abundance. "No place in the world," says Mr Maundrel, "can promise to the beholder at a distance a greater voluptuousness;" and he mentions a tradition of the Turks, that their prophet, when approaching Damascus, took his station upon a certain precipice, in order to view the city; and, after considering its ravishing beauty and delightful aspect, was unwilling to tempt his frailty by going farther, but instantly took his departure with this remark, that there was but one paradise designed for man, and that for his part, he was resolved not to take his in this world.

Climate. The air or water of Damascus, or both, are supposed to have a powerful effect in curing the leprosy, or at least in arresting its progress, while the patient remains in the place. But, with all those advantages, the climate is represented by Volney as deficient in point of salubrity. The white waters of the Barrady are found to be cold and hard; the natives are subject to frequent obstructions; their fair complexions are considered as rather a sickly paleness, than the natural colour of health; and the excessive use of fruit, is productive, during the summer and autumn seasons, of intermittent fevers and dysenteries. Damascus is 23 leagues east of Sidon, 45 north of Jerusalem, and 65 south of Antioch. See Volney's *Travels in Syria and Egypt*, vol. ii.; Brown's *Travels in Africa;* Niebuhr's *Travels in Arabia;* La Brocquiere's *Travels in Palestine;* and Maundrel's *Journey from Aleppo to Jerusalem.* (q)

DAMASCUS, Pashalic of, is the first in Asia, and is one of the five into which Syria is divided. It comprehends the whole eastern part of that country, being bounded on the north and west by Tarabolos, on the south-west by Palestine, and on the east by the desert of Arabia. It extends from Marra on the road to Aleppo, as far as Hebron, in the south-east corner of Palestine; is bounded on the west by the mountains of the Ansares, Libanus, and the upper part of Judea; crosses the Jordan, including Jerusalem, Nablous, and Hebron; enters the Arabian desert towards the East, as far as the country is capable of cultivation; and, in the district of Tadmor or Palmyra, stretches fully five days journey in that direction. In this vast extent of country, the soil and its productions are extremely various. The plains of the Hauzan and the banks of the Orontes are the most fertile; and produce wheat, barley, dowra, sesamum, and cotton. The countries around Damascus and the Upper Bekaa, are of a reddish gravelly soil, better adapted for fruits and tobacco, than for the production of grain. The mountainous districts are appropriated to olives, mulberry, and fruit-trees, and in some places to vines, from which the Greeks make wine, and the Mahometans dried raisins. The office of the pasha of Damascus since the decline of the Turkish empire, is in a great measure hereditary; and the person, who holds that office, is invested with absolute power, from which there is no appeal. His public revenue is calculated by Mr Browne to amount to ten thousand purses, or half a million sterling; and arises chiefly from a duty upon lands, and the capitation tax paid by Christians. He possesses, indeed, other sources of emolument, particularly fines and arbitrary exactions; profits upon money lent to merchants and farmers, frequently at fifteen or twenty per cent.; and his privilege of heir to all the pilgrims who die on their journey to Mecca. His military establishment consists of six or seven hundred Janissaries, the same number of Barbary Arabs, who are little better than naked banditti, and eight or nine hundred Dellibashas or horsemen. These troops are employed, in the first instance, in collecting the *miri*, or land-tax; and every year, three months before the departure of the caravan to Mecca, he makes what is called his circuit, travelling through his territories, raising contributions from the towns and villages. These exactions, which are not always confined to the legal assessment, are seldom made without resistance on the part of the subjects; and particularly in the district of Nablous or La Maria, where the inhabitants are wealthy and powerful, the oppressions of the government are frequently withstood. But the most honourable office of the pasha of Damascus, and the regular occupation of his soldiery, is to protect the sacred caravan of Mecca from the plundering Arabs of the desert. He enjoys the distinguished title of Emir-el-Hadjé, or chief of the caravan, by office; and so important is this charge reckoned by every Mahometan, that when a pasha has acquitted himself well as conductor of the pilgrims, his person becomes inviolable even by the Sultan, and it is not permitted, on any account, to shed his blood. It is said, however, that, without departing from the letter of the law, the Divan sometimes extends its vengeance to those who are protected by this privilege, by ordering them to be smothered in a sack, or pounded in a mortar. The pasha of Damascus is not only charged with the duty of conducting the caravan, but also with the burden of its expences, which are calculated at five or six thousand purses, besides one thousand required for its own use on the journey. The advances for the caravan consist in the hire of camels for the pilgrims, the purchase of provisions in barley, corn, rice, &c. and the payment of certain sums to the Arab tribes, who dwell near the route, in order to secure a safe passage; though some of the more enterprising pashas have been known to conduct the caravan, sabre in hand, without paying a piastre to these plunderers. When the caravan sets out, the pasha receives from the governor of the castle the Sonjiak Sherifi, or ensign of the prophet, for which he gives a receipt in writing before witnesses, and which he solemnly pledges himself to bring back in safety. As soon as he arrives near the city, on his return, a messenger is dispatched to Constantinople, who is obliged to perform the journey in twenty-five days, and who carries with him water from the well Zem-zem near Mecca, and some dates from Medina to be presented to the Emperor on his visit to the Mosque. The following account from Mr Browne, of the pasha's entrance into Damascus, after the return of the caravan, will furnish the best idea of the power and attendance of this provincial despot. "First appeared three hundred dellis or cavalry, mounted on Arabian horses, variously armed and clothed, but on the whole, forming no mean display. These were succeeded by fifteen men on dromedaries, with musquetoons or large carbines, placed before them, and turning on a swivel in every direction. Some of the great officers of the city followed, well mounted and decently attired. Then came part of the pasha of Tripolis' Janissaries, well clothed and armed; that pasha himself with his officers and the remainder of his guard. Next was the tattarawan belonging to the pasha of Damascus, another body of four hundred dellis, a company of thirty musquetooners, a hundred and fifty Albanians in uniform, and marching two and two, like our troops. Before the latter was borne the standard of the prophet Sonjiak Sherifi, of green silk, with sentences of the Koran embroidered in gold, and the magnificent canopy brought from Mecca, guarded by a strong body of Muggrebins, or western Arabs, on foot. Then passed the pasha's three tails (generally of white horses) borne by three men on horseback; twelve horses richly caparisoned, and each bearing a silver target and a sabre; six led dromedaries, in beautiful housings; numbers of the chief persons of the city followed, among whom was the aga of the Janissaries, the governor of the castle, and the mohassel. Last came the pasha himself in a habit of green cloth, adorned with fur of the black fox, preceded by his two sons, all mounted on the most spirited steeds of Arabia, and followed by his household troops to the number of four hundred well armed and mounted. More than a hundred camels had preceded the rest, bearing the tents and baggage of the pasha." See Volney's *Travels in Syria and Egypt*; Browne's *Travels in Africa, Egypt, and Syria*; and La Brocquiere's *Travels in Palestine*. (*q*)

DAMASK, in the manufacture of cloth, is a variegated texture, richly ornamented with figures of flowers, fruits, landscapes, animals, &c. woven in the loom, and is by far the most rich, elegant, and expensive, species of ornamental weaving, tapestry alone excepted. The name is said to be derived from Damascus, which is thence inferred to be the original seat of this manufacture; but it is highly probable that this etymology rests more upon conjecture derived from affinity of sound, than upon any precise or respectable authority.

Damask belongs to that species of texture which is distinguished by practical men by the name of tweeling, or tweeled cloth, (French *touaille*,) of which it is the richest species. The tweel of damask is usually half that of full *sattin*, and consequently consists of eight leaves moved either in regular succession or by regular intervals, eight leaves being the smallest number which will admit of alternate tweeling at equal intervals.

In the article Cloth Manufacture, a representation has been given of the damask draw-loom, and some explanation of its principle and mode of operation. To these shall be added, in the present article, such further remarks on this curious manufacture as seem most important; and a few practical observations on the nature, operation, and use of the draw loom, the most extensive, complicated, and ingenious apparatus used in the fabrication of cloth.

The principle upon which the fabrication of ornamen[ts]

Damask.

tal figures, interwoven with tweeled cloth, is the combination of two lines at right angles to each other. That portion of yarn which is stretched in the loom, and which weavers distinguish by the name of *warp*, forms a superficies consisting of a very great number of parallel straight lines, contiguous to, or in contact with, each other, but until bound together by the intersection of the *weft* or *woof*, without any cohesion either chemical or mechanical. The intersection of the woof at right angles with the warp, forms the bond of cohesion, and gives the tenacity required tô form the flat substance called cloth. In the common texture the intersection is uniformly betwixt every individual thread, and the superficies of the cloth, when woven, presents a complete uniformity of appearance, all the intersections being uniform and equidistant betwixt every alternate thread.

The generic difference of tweeling, when compared with common cloth, consists in the intersections, although uniform and equidistant, being at determinate intervals, and not between the alternate threads. Hence we have specimens of tweeled cloth, where the intersections take place at the third, fourth, fifth, sixth, seventh, eighth, or sixteenth interval only. The threads thus deflecting only from a straight line at intervals, preserve more of their original direction, and a much greater quantity of materials can be combined in an equal space, than in the alternate intersection, where the tortuous deflection at every interval keeps them more asunder. On this principle tweeled cloths of three and four leaves are woven for facility of combination alone. The coarser species of ornamented cloths, known by the names of dornock and diaper, usually intersect at the fifth, or half satin interval. The sixth and seventh are rarely used, and the intersection at the eighth is distinguished by the name of satin in common, and of damask in ornamental tweeling. It will further be very obvious, that where the warp and woof cross only at every eighth interval, the two sides of the cloth will present a diversity of appearance; for on one side the longitudinal, or warp threads, will run parallel from one end of a web to the other, and on the other the threads of woof will run also parallel, but in a transverse direction across the cloth, or at right angles to the former. The points of intersection being only at every eighth interval, appear only like points; and in regular tweeling these form the appearance of diagonal lines, inclined at an angle of 45° (or nearly so) to each of the former.

The appearance therefore of a piece of common tweeled cloth is very similar to that of two thin boards glued together, with the grain of the upper piece at right angles to that of the under one. That of an ornamented piece of damask may, in the same manner, be very properly assimilated to a piece of veneering, where all the wood is of the same substance and colour, and where the figures assume a diversity of appearance from the ground, merely by the grain of the one being disposed perpendicularly to that of the other.

From this statement of the principle, it results that the most unlimited variety of figures will be produced, by constructing a loom by which every individual thread of warp may be placed either above or below the woof at every intersection; and to effect this in boundless variety, is the object of the draw loom.

Besides what has been already stated under the article Cloth Manufacture, the reader will find some details respecting the draw loom, as modified to produce ornamental figures upon double cloths, by referring to the article Carpet, where he will also find a plan and description of a draw-loom capable of being wrought by mechanical power, and adapted to those peculiarities which distinguish carpet, or double-cloth weaving, from damask or satin tweeling. In order to complete the plans for applying power to ornamental texture, he will now find in Plate CCXXVII. a perspective representation of a draw-loom adapted for damask tweeling, and which, although in some respects similar in principle to the other, possesses many distinguishing properties necessary to fit it for its immediate object. By comparing the three, he will thus be able to form a comprehensive estimate of their respective uses, and the distinctions of their construction.

Plate CCXXVII.

Fig. 1.

Fig. 1. is an oblique perspective representation of the loom, of which the following are the chief constituent parts upon which the peculiarity of construction depends. The posts and cross-sails which constitute the framing are respectively at AAAA and at *aaaa*. The yarn, or warp beam, is at B. The perforated board, or frame which regulates the harness, is at C; the frame of directing pullies is above at D; the tail of the harness is at M, and the board, or table, as weavers call it, to which its extremity is attached, is at E; the simples, or descending cords, are at L, their extremities being fixed to the floor at O. In these parts there is little difference from any ordinary draw-loom, excepting in the obliquity of the simples at L, which keeps them closely in contact with the cylinder or barrel G, by which they are moved. The heddles, which consist of eight leaves, with the long eyes common in every species of harness-work, as there is nothing peculiar in their construction, and as they must be almost entirely concealed by the harness, are entirely omitted, as are also the lay and cloth beam for the same reasons. The eight treddles, or levers, which give motion to the heddles, appear below at I, and these are moved by the revolution of the shaft S, which takes the motion from the power by a pulley and belt in the common way, and which, as it communicates the motion, either directly or indirectly, to every other part, may be regarded as the *primum mobile* of the whole engine. On the shaft S is a succession of eight wipers, or traverse wheels, which successively move all the treddles, so that woof is eight times inserted by every revolution of the shaft, the motion of which must, of course, be very slow, not exceeding at the utmost eight revolutions per minute; and if the loom be wide, even this will be found too much. The wipers are all similar, and are shaped to effect uniform reciprocating motion.

The barrel, or cylinder G, receives its motion from the shaft below, by means of the catch H, and the upright spindle L, which are moved by pins in the shaft as often as the harness is to be shifted, instead of the catch, which is drawn aside and returned by the operation of the cord K, acting by a weight at its opposite extremity. Here it may be proper to remark, that this motion may be very conveniently, simply, and cheaply effected, merely by a straight lever moving on or near its centre, one extremity of the lever being jointed to the vertical rod L, and the other projecting over a wiper fixed on the shaft S. The extremity over the shaft, whenever elevated by a protuberance on the wiper, would depress L, and move the barrel, after which it would return by its own weight to its former position, until again set in motion. The latter plan is most simple, and avoids all difficulty in fitting and disengaging the catch.

Every operation of the most complicated damask draw-loom will thus be performed without either weaver or draw-boy; and as the yarn employed in the damask manufactory, as practised at Dunfermline and other places in the east of Scotland, is very strong, little further labour would be required than that of dressing the warp, and occasional superintendance. It would be proper, indeed, to employ a boy or girl to watch the progress of every loom, as is the case in other kinds of power weaving.

It remains only to make some general remarks upon the construction of the barrel; the range of pattern which it is capable of producing in its most simple form; the means of extending that range to the most complicated designs; and to add such other miscellaneous remarks as the nature of the machinery and operation may suggest.

When the range of a draw loom pattern is very extensive, covering many designs, the number of simples must be increased proportionally, as has been shown under the article Cloth Manufacture, where no less than *three* distinct sets of *simples* and *lashes* are supposed necessary, and that these must be used successively before the whole range of an extensive pattern can be completed. Under similar circumstances, some such expedient must also be adopted in this loom, and it is not very difficult to devise one; for different sets of simples may be used in the same way; and if the pattern be too comprehensive to be included in one revolution of the barrel, without increasing its diameter to an inconvenient size, two, or even three or four, may be successively used, until the design is completed. The barrel being constructed to revolve on centres, a very few minutes only will be lost in changing a set of simples and a barrel, and as the former operation is necessary in all extensive draw looms, the other may be done at the same time by an additional person, without a moment being lost. If we suppose the barrel 2 feet diameter, as in the scale, and four feet long, it will present a circumference of 6 feet, which, allowing $\frac{1}{8}$ of an inch to each simple, will move 384 of these as required. Again, if the harness is to be lifted three inches, and we reduce the range of the barrel to one inch, by the means suggested in the description of the carpet power draw-loom, or any other which may appear preferable, we shall have 864 changes by one revolution. Perhaps one of the best and most simple ways of reducing the range of the barrel, would be to substitute levers, bent at right angles, for the pullies in the frame. If the horizontal part of the lever, to which the harness cords are attached, were, for instance, six inches, and the vertical part, which is connected with the tail cord, 2 inches, the range of the harness would be to that of the barrel in the ratio of 3 to 1, and were the perpendicular part but one inch, of 6 to 1; but we are to recollect, that, from the way in which the simples are attached to the tail, so much range is lost, that a further allowance must be made for this. There is another contrivance used for raising the harnesses of draw-looms, which is known by the name of the patent draw-loom. These have been for many years in actual practice at Dunfermline, and their principle may be very easily applied to a barrel draw-loom, worked by power. The limits of this article will not admit of a detailed description, which indeed could not be rendered intelligible without a plate. The principle consists in the use of a lever, the end of which resembles a common garden rake, or coarse comb. The harness has neither pullies, tail-cords, nor simples, but hangs vertically from the roof. The lashes pull all the cords required to be lifted into the intervals between the teeth of the comb; and every cord being furnished with a knot, immediately above the teeth, the whole are lifted at once by the operation of the lever.

Such an apparatus might possibly be found advantageous, in some instances, in the power draw-loom, and it might be very easily applied. The simples at L, and box at D, might be removed as unnecessary; the barrel placed before the table R, and the comb immediately under; the knots would be pulled between the teeth by the operation of the barrel, and the comb-lever might be worked by a wiper on the shaft S below. (J. D.)

DAMASONUM, a genus of plants of the class Hexandria, and order Hexagynia. See Botany, p. 193.

DAMIETTA, or Damiatt, is a town of Egypt, situated on the eastern bank of the Nile, and about 5 miles from its mouth. It stands upon a tongue of land, stretching about 6 miles from east to west, and bounded on one side by the river, and on the other by the western extremity of the Lake Menzale. The town, which is very large, is rounded in a semicircle, and from one end of the crescent the whole extent of it may be seen. The houses, particularly those on the banks of the river, are very high, and have commonly handsome saloons built on the tops of their terraces. The principal ornaments of the town are the squares, the chief of which has retained the name of Menchie (the original name of the town); the mosques, which are adorned with lofty minarets; the public baths, which resemble those of Cairo, and are lined with marble; the bazars, and the khans or okals, which are filled with great varieties of merchandise.

Damietta was formerly celebrated for its fine gardens, which abounded with orange groves, and produced every kind of fruit; and where the finest rice was raised in the greatest abundance. Owing, however, to the stream of the Nile having been taken to the canal of Menouf, instead of passing by Damietta, its gardens have disappeared, its rice fields are sown with wheat, and not even fresh water can be obtained. This evil, however, has been in a great measure removed by Achmet Aga, who has constructed a large vessel for bringing water to the town. It is conveyed in vast cisterns from above Fareskour, where the river has sufficient force to drive back the salt water.

In descending the river from Damietta to Lesbe, the houses on its banks have a very picturesque appearance. Stages are generally stretched across the river, on which vines are planted, and seats erected under their shade. The village of Lesbe, which is distant only a mile from the sea, was destroyed by the French, who left upon its site an unfinished fort. It has a high brick wall, without any fosse or glacis, and there are in the interior three excellent barracks; but the remains of the old houses were not carried away. Lord Valentia could not discover any of the ruins mentioned by Savary as existing in his time, and which he imagined to have been part of the ancient Damietta. He could find neither vestiges of walls, nor heaps of pottery, nor any appearance of lime and brick mingled with the soil; and even in the places through which the canal has been cut, no remains were to be seen. Achmet Aga, the governor, has erected a thriving village below

Lesbe, in which he obliges all the fishermen to reside, that they may give assistance to vessels in distress, or when wrecked on the shore. Here Lord Valentia observed a round tower of ancient masonry, which forms the extremity of a building that reaches to the river; and he is of opinion that the great iron chain which was formerly stretched across the river was fastened to this edifice.

In order to prevent a hostile fleet from entering the river, the mouth of it is choked up with a bar called Boyaz, which is not so impassable as the bar at Rosetta. It admits ships of much larger burthen than the Scherms or Jerms, which are employed in loading and unloading the ships in the road. The vessels which are able to get over the bar anchor close to the town in fourteen feet of water.

Damietta carries on a very considerable commerce with Syria, Cyprus, and Marseilles. Its principal exports are rice, of which six millions worth is annually exported, linens, sal ammoniac, and corn, the last of which is sent off under the name of rice, as its exportation is prohibited.

In the numerous villages which encircle Damietta, are fabricated the most beautiful linens, and particularly a kind of napkins fringed with silk.

There are few remains of antiquity in this town. Lord Valentia saw the ruins of an ancient granite obelisk, which is nearly worn away, and which is mentioned by Andreossi as forming the door sill of the barracks. He also found near the door of a merchant, two pedestals, one of which contained the following Latin inscription.

LICINIAE LF SECUNDAE
DOMITI CATULLI.

The other, which was partly concealed by a step, exhibited when removed the following Greak inscription.

Η ΒΟΥΛΗ ΚΑΙ Ο ΔΗΜΟΣ
ΛΟΥΚΙΟΝ ΠΟΠΙΛΛΙΟΝ ΒΑΛΒΟΝ
ΠΡΗΣΒΕΥΤΗΝ ΤΙΒΕΡΙΟΥ
ΚΛΑΥΔΙΟΥ ΚΑΙΣΑΡΟΣ
ΣΕΒΑΣΤΟΥ ΓΕΡΜΑΝΙΚΟΥ
ΤΟΝ ΠΑΤΡΟΝΑ ΤΗΣ ΠΟΛΕΟΣ.

The owner of these pedestals informed Lord Valentia, that they were brought in a vessel from Syria. Andreossi mentions a Greek inscription on a column in a mosque, which Lord Valentia copied, and of which he has given an engraving. He considers it as cabalistic. At Menchie, a suburb nearer the sea, he found an Arab inscription, which places its erection in the 1117th year of the Hegira. It contained several beautiful marble columns greatly injured, and near it was a marabout, having its dome sustained by four columns of jasper, which had preserved their polish in a remarkable manner. A fifth jasper column was placed at the entrance.

The greater number of authors who have written upon Egypt, such as Sicard, Pocock, Prospero Alpini, Shaw, Maillet, and Niebuhr, have supposed that the modern Damietta was built upon the site of the ancient town. Savary, however, is of opinion, that ancient Damietta occupied the spot on which the village of Lesbe now stands, and in proof of this, he mentions the ruins which Lord Valentia could not discover. "The mosque which Savary mentions," says Lord Valentia, "could not be the one left when the Sultan of Egypt destroyed the town, as it is of a modern date. Certainly if Savary have faithfully translated the quotations he has given from Macrizi and Abulfeda, there can be no doubt that the ancient Damietta was destroyed, in order to prevent its being taken from the Christians, and a new town of the same name was built higher up the river; yet it is difficult to comprehend what advantage would arise from removing it only a few miles to the site of the present town, or indeed for its removal at all, since the walls and fortifications alone were of importance, and their complete destruction would have precluded the possibility of its again becoming an asylum to a vanquished enemy." Population of the town 80,000. Distance from Cairo, 84 miles N. N. E. East Long. from Greenwich observatory 31° 57′, and North Lat. 31° 25′ 40″. See Savary's *Letters on Egypt,* vol. i.; Niebuhr's *Travels in Arabia,* vol. i.; and Lord Valentia's *Voyages and Travels to India, Egypt, &c.* vol. iii. p. 416—421. (π)

DAMP. See *Coal* MINES.

DAMPIERA, a genus of plants of the class Pentandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl. &c.* p. 587, and BOTANY, p. 175.

DANÆA. See FILICES.

DANCE. See RECREATIONS.

DANDA. See ANGOLA and CONGO.

DANNEMORA, the name of the most celebrated iron mine in Sweden, is situated in the province of Upland, about one English mile from Osterby, and 30 English miles north of Upsal. This mine was discovered in the year 1448, and though it has been now wrought for nearly 366 years, it still yields abundance of the best iron in Europe. It was originally wrought as a silver mine, the silver being found in the galena; but when this became unproductive, the attention of the proprietors was directed exclusively to its iron ore. At first it belonged to the King of Sweden, but that monarch consigned it to the Archbishop of Upsala as a part of his revenues; and it now belongs to a number of private individuals, each of whom works it separately on his own account.

The iron mine is on a hill, which has scarcely the appearance of being elevated above the surrounding country. It is about two English miles long, and nearly half a mile broad, and is encircled by lakes, those of Dannemora, Films, and Grufve being quite close to it. On the side where there are no lakes, there is a turf moss. The ore forms a large vein in this hill, which stretches in a north-west and south-east direction. The mine was some years ago inundated by the water from the adjacent lakes. A strong wall, however, has been built to keep off the water. It is drained by means of two steam-engines, kept going by means of wood for fuel.

At the side of the mine is a large opening, about 50 fathoms deep and 50 wide, and at the lower part of this is the entrance to the mine, which is wrought about 30 fathoms deeper than this opening. The ore is blasted by gunpowder. The part of the vein at the mouth of the mine is called *stor rymning*; the next portion, called *jord grufva,* earth mine, yields the finest ore; and the portion farthest south, called *sodra grufva,* or southern mine, yields the worst ore, probably from being mixed with galena and blende. The rock through which the vein runs is said to be quartz. The substance immediately contiguous to the vein appeared to Dr Thomson to be hornstone, and to contain hornblende. The ore itself contains limestone, quartz, and actinolite, and affords from 25 to 75 per cent. of cast iron. In the worst kind of ore, Dr Thomson also perceived blende, fluor spar, galena, and amethyst, but in small quantities.

Dante. Carbonate of lime, crystallized in dodecahedrons, also occurs in this vein; and likewise sulphate of barytes, mountain cork, and the aplome of Hauy.

After the ore is broken into small pieces and roasted, it is put into conical-shaped furnaces constructed of the slag from cast iron. In these furnaces it is mixed with the proper quantity of charcoal, and then melted and separated from the slag. The cast iron obtained in that manner is as white as silver, completely crystallized, and very brittle. This cast iron is reduced to malleable iron, by heating it in a bed of charcoal, and hammering it out into bars. In this state it is whiter than common iron, is less liable to rust, is distinctly fibrous in its texture, and much stouter than any other iron.

The quantity of iron yielded by this mine every year, amounts to above 4000 tons; it is all sent to England, the greater part of it being purchased by a merchant in Hull. It is all converted into steel, and may be known by a mark of three balls.

Some chemists ascribe the superiority of the Dannemora iron to the presence of manganese. Berzelius attributes it to the presence of the metal of silica, while others, with more reason, suppose it to arise from the nature of the process employed. In the neighbourhood of the mines are establishments for forging the iron, and for the accommodation of more than 300 workmen with their families. Each of the little villages has three or four regular streets, often planted with trees, a church, a school, and an hospital. See Coxe's *Travels*. Catteau, *Voyage en Allemagne et en Suede*, tom. ii. p. 292; but particularly Dr Thomson's *Travels in Sweden during the Autumn* of 1812, chap. x. p. 186—192, to which we have been indebted for the greater part of the preceding information. (π)

DANTE, Alighieri, one of the earliest and most celebrated poets of modern Italy, was born of an illustrious family at Florence, in the year 1265. At a very early age he displayed genius of a superior order, and applied himself successfully to the study of philosophy and literature, under the tuition of Brunetto Latini. When grown up to manhood, he eagerly engaged in the business of public life, and raised himself by his abilities, to an eminent rank amongst his fellow citizens of the republic of Florence. He appears to have commenced his public career in the military profession; in which he acquired considerable reputation; having distinguished himself, by his bravery, in the battle of Campaldino, or Arezzo, where the Florentines obtained a signal victory. In the year 1291, he espoused Gemma, the daughter of Manetto de Donati, a lady whose disposition was by no means calculated to contribute to his domestic happiness and comfort; and from whom he separated after she had brought him several children.

The superior talents and acquirements of Dante soon paved the way for his advancement to the highest honours of the state. In the year 1300, he was appointed one of the chief magistrates of the Florentine republic; a situation, however, which, at that troublesome period, exposed him to many dangers, and eventually proved the occasion of his ruin. Italy was, at that time, kept in a state of continual agitation by the opposite factions of the *Guelphs* and *Ghibellines*, which were the cause of so much animosity and bloodshed; and the city of Florence was, moreover, distracted by the turbulent parties of the *Neri* and *Bianchi*, or Blacks and Whites; a distinction originating from a private quarrel between the two noble families of the *Cherchi* and *Donati*. Dante unfortunately embraced the cause of the White faction, and his party having been ultimately overpowered, sentence of banishment was pronounced against him, his possessions were confiscated, and his house razed to the foundation. Dante.

At the time these proceedings took place, Dante was absent from Florence. But the news of the sentence reached him at Sienna, on his return; and seeing himself there surrounded by a numerous and illustrious band of exiles, he associated with them, and, under the conduct of Alessandro di Romena, this army made repeated attempts, during a period of four years, to regain possession of their native city. All these attempts, however, proved unsuccessful; and the band of exiles, at length, seeing their hopes frustrated, dispersed. Dante repaired to the court of Verona, where he found a patron in the great *Cane de la Scala*, Prince of Verona, whom the poet has celebrated in the first Canto of the *Inferno*. But his residence there was short; the treatment which he experienced at the Veronese court did not accord with his talents and temperament; and he found it necessary to seek his fortune elsewhere. From Verona, therefore, he retired to France; where he endeavoured to attract the notice of the learned; and, as Boccacio informs us, disputed with great reputation in the theological schools of Paris.

In the year 1308, Henry, Count of Luxemburgh, was elevated to the imperial dignity; and Dante seems to have conceived the hope of being restored to his native city, through the influence and exertions of that prince. Accordingly he attached himself to the interests of the new emperor, and endeavoured to conciliate his favour, it is supposed, by the composition of his Latin work *De Monarchia*, in which he asserted the rights of the empire against the encroachments of the papacy. In the year 1311, the emperor laid siege to Florence, but was baffled in his attempt to take the city; and his death, which happened in 1313, deprived Dante of all hopes of re-establishment in his native country.

For some time after this period, we have no certain accounts of the circumstances of his life; but he is supposed to have wandered about Italy, for several years, in a state of poverty and dependence; until at length, through the friendship and patronage of Guido Novello de Polenta, he procured an honourable establishment at Ravenna; where he continued to reside during the few remaining years of his life. In the service of this new patron, he was employed, as ambassador, to negociate a peace with the Venetians, who were making preparations for hostilities against Ravenna. On his arrival at Venice, however, he was unable to procure a public audience; and the fatigue of the journey, together with the mortification he experienced from the ill success of his mission, threw him into a fever, which terminated in his death, on the 14th of September 1321, in the 57th year of his age. His remains were magnificently interred by Guido; who also took upon himself the office of pronouncing the funeral oration, and, at the same time, expressed his intention of erecting a splendid monument to the deceased; an intention which his own subsequent misfortunes deprived him of the power of executing. This honourable task was afterwards performed by Bernard Bembo, the father of the celebrated cardinal, who raised a handsome monument, with a suitable inscription, over the neglected ashes of the poet.

The Florentines, as if to expiate their resentment against the illustrious poet, whom they had so unrelentingly persecuted when alive, made repeated fruitless attempts to recover his bones from the city of Ravenna. In the age of Leo X they made a solemn application to the Pope for that purpose; and the celebrated Michael

Angelo, an enthusiastic admirer of Dante, generously offered to execute a magnificent monument to the memory of the poet. But this application was likewise unsuccessful. To evince, however, the very high estimation in which his talents were held in his native city, the republic of Florence, in the year 1373, assigned a public stipend to a person appointed to read lectures on the *Divina Commedia;* and the first individual engaged in this office was the celebrated Boccacio. A sumptuous monument was raised to the memory of Dante, in 1780, by the legate Cardinal Gonzaga, bearing the inscription: "*Danti Aligherio, poetæ sui temporis primo, Restitutori politioris humanitatis.*" A few years ago, we were informed by some of the literary journals, that a subscription had been opened at Florence, for defraying the expence of a public monument proposed to be erected in honour of their great native poet; and that a drawing of the intended structure had been submitted to the Florentine Academy of the Fine Arts, which met with general approbation. We are ignorant whether the intended monument has been since executed.

Boccacio describes Dante as a man of middle stature; his demeanour was solemn, and his walk slow; his dress suitable to his rank and age; his visage long, his nose aquiline, his eyes full, his cheek bones large, and his upper lip projecting over the under one. His complexion was olive; his hair and beard thick and curled. His manners were grave and sedate; his deportment, in public and private life, was regular and exemplary; and he was extremely temperate in his way of living.

Dante is the author of several works, both in prose and in verse; but his fame now rests entirely on his great poem, the *Divina Commedia.* At what period, and in what place, he composed this singular poem, has not been precisely ascertained by any of his numerous commentators. Boccacio affirms that he began it in his thirty-eighth year, and had finished seven cantos of the *Inferno* previous to his exile from Florence. The beginning of the poem is said to have been fortunately preserved from the wreck of his effects; and being afterwards restored to the poet, he was induced to continue it, amidst all the embarrassments of an unfortunate and agitated life. At what time he completed it is equally uncertain; but it was probably finished during his residence at Verona, as he dedicated the *Paradiso* to his Veronese patron.

When we take into consideration the various disadvantages under which this poem was composed,—whether resulting from the private circumstances of the poet, or from the general complexion of the times in which he flourished; we shall find sufficient reason to admire the genius that was capable of producing such a work, at an æra by no means favourable to the developement of poetical talents. Before Dante appeared, very little progress had been made in the cultivation of the vulgar dialect of Italy, as a learned or poetical language. At that period, the studies of literary men were almost exclusively devoted to the dialectics of the peripatetic philosophy, and the sophisms of polemical science. The ancient models of polite literature had scarcely yet exerted their influence in purifying corrupted taste, restraining the license of ungoverned imagination, and conducting the efforts of genius to the more cultivated regions of poetical fancy. On the accession of Charles of Anjou to the throne of Naples, that restless prince made some small compensation for the animosities, which he introduced or fostered among his subjects and neighbours, by transporting the *Provençal* poetry from France to Italy. Upon the wild, but often spirited compositions of the French *Troubadours,* the genius of the first Italian poets appears to have been formed; and it is not improbable that from these productions Dante may have caught some of the earliest sparks of that poetical flame, which afterwards shone forth with such lustre, in the *Divina Commedia.*

In this extraordinary production, the author is conducted in a vision, through hell, purgatory, and paradise; which gives occasion to the tripartite division of the poem. Although Dante is generally classed among the epic poets, the *Divina Commedia* displays more of the didactic, than of the epic character. Hell, purgatory, and paradise, are employed by the poet as so many theatres for the exhibition of a variety of characters of all ages and conditions; the poem, in the midst of much occasional extravagance, abounds in the most sublime images and sentiments; and there are few works of genius which display a more intimate knowledge of the human soul, or contain a more ample store of the most useful precepts and practical maxims for the conduct of life. The works of Dante have been accused of obscurity and harshness. These scrictures must be meant to apply either to the matter, or to the style, or to both. With regard to the first, great allowance ought to be made for the prepossession of the age in favour of scholastic learning, to which every author, who aspired to reputation, was, in some measure, forced to accommodate himself; and, in the second place, it must be remembered, that many forms of expression had, through the influence of time, and the neglect of succeeding writers, become obsolete, which, in the age of Dante, were in current use. The lyrical poems of Dante are, in the opinion of Muratori, no less worthy of estimation than his larger work.

There are numerous editions of the *Divina Commedia;* that which was published at Venice, 1757, in three vols. 4to, is esteemed the best. Dante had three sons, each of whom wrote a commentary on their father's poem. The *Divina Commedia* has been translated into English verse by the Rev. Henry Boyd, with notes and illustrations, London, 1802, in three vols. 8vo. See the Life prefixed to Mr Boyd's translation of Dante; also *Gen. Biog.* Muratori *Storia della ling. Ital.* The reader will likewise find some particulars relative to Dante in the Notes to Hayley's *Essay on Epic Poetry.* (*z*)

DANTHONIA, a genus of plants of the class Triandria, and order Digynia. See BOTANY, p. 114.

DANTZIC, GDANTZK, or DANTZIG, the *Gedanum* of the ancients, is a large city of Polish Prussia, in the palatinate of Pomerellia, or Little Pomerania. It is situated about four miles from the embouchure of the Vistula, and on one of the branches of that river, which form the island called the Dantziger Werder.

Dantzic is divided into three towns, the Fore Town or Vorstadt; the Old Town or Altstadt; and the Rechtstadt. The suburbs, the greater part of which were burnt during the siege in 1806, had the names of Old and New Scotland, Stoltzenberg, Hagelberg, Bischofsberg, Schidlitz, and Langefuhr. The suburbs of Old and New Scotland were formerly inhabited by Scotch families, who had settled in the town, on account of particular privileges having been granted to them, in consequence of services rendered to the city by a Scotch family of the name of Douglas. The suburb of Stoltzenberg stands on a sandy hill, and commands a fine prospect of the town and harbour. The Radaune and the Motlau, two small rivers, run through the city. The houses in Dantzic are built of brick and stone, and are commonly three or four stories high. On the outside of the ground floor there is a kind of gallery called *Beyschlag*, which projects into the street, and in the middle of which is the chief entrance. The principal public buildings are the cathedral; the building which was formerly the college of the Jesuits; the Lutheran college; the Hotel de Ville; the Court of the Nobles; the Junker-Hof, or the Court of Artus; the church of St Catherine and the tomb of Hevelius; the mill upon the Radaune; the gate of the Lang-gasse, and the green gate. The chief curiosities in the cathedral, which is one of the finest churches in Europe, are the organ, the baptistery, and the picture of the last judgment: The hotel de ville is a handsome building, and has a library and a cabinet of painting, in which are the original manuscripts of the *Selenographie,* and the *Machina Celestis* of Hevelius. The arsenal contains the marble monument which Sigismond had carried to be sculptured in Italy in honour of his father the king of Sweden; and the Junkerhof, which is the place of exchange, contains a marble statue of Augustus III.

The principal literary establishments are the Gymnasium, the Physical Society, and the Society for the promotion of Commerce. The library of the Gymnasium possesses about 30,000 volumes. The Physical Society has an excellent zoological and mineralogical collection. The Cabinet of Curiosities belonging to Scheffler, contains more than 4000 masses of yellow amber. The library of the church of St John is also worthy of notice. Besides the public buildings which have been mentioned, Dantzic contains seven Lutheran churches, two belonging to Calvinists, and one Roman Catholic chapel.

The public granaries, which consist of a great many buildings four or five stories high, form a separate town, called Speicher Island, encompassed by water, and communicating with the city by a draw-bridge. A number of fierce mastiffs are kept for the defence of the granaries, and are let loose at 10 or 11 o'clock at night.

The harbour of Dantzic is very large, and there is a good canal which communicates with the Motlau, and is very convenient for the transportation of merchandize. It is defended by a fortress at Weichselmunde, and there is a lofty tower which serves for a light-house. Ships which draw more than eight feet of water cannot enter the canal which leads from the Vistula to the city; but their cargoes are conveyed in barks called *bordings*.

Dantzic has long been regarded as one of the principal granaries of Europe. The corn received from Poland, which is annually exported from Dantzic, is computed at 730,000 tons, or 365,000 lasts. It is brought from Poland in sloops of from 30 to 60 tons, which bring also the other productions of Poland, namely, potash, flax, wax, masts, wood for shipbuilding, staves, superior to those of Hamburgh. Poland in return draws from Dantzic about 2000 tons of Swedish iron annually; articles of Indian manufacture, linen cloth, silks, brandy, and wines. The principal exports from Dantzic are the masts of ships, cork wood, hemp and flax, potash (called the alkali of Dantzic), honey, wax, tallow, steel, iron, copper, lead, saltpetre, tar, amber, skins, furs, wool, and salt from Poland. In the year 1788, the following estimate was made of its commerce. The 60,000 lasts of corn which came from Poland amounted, at 18 ducats per last, to about 2,080,000 ducats. The other articles, as wood, potash, linens, skins, honey, &c. which came from Poland, amounted to nearly the same sum; so that there was an annual capital of 6,000,000 rix-dollars vested in commerce. The profit upon this sum amounted to about 1,200,000 rix-dollars, from which deducting 150,000 for taxes, custom-house dues, and the interest of money, there is left 900,000 rix-dollars for the annual profit upon their commerce.

In some particular years the trade of this city was so great that the barks and vessels which came down the Vistula from Poland and Prussia, amounted to 1288, and the ships which arrived and cleared out of its harbour were 1054. In 1802, 1674 ships entered Dantzic, and 1916 cleared out. The following is a list of them.

	Arrived.	Cleared out.		Arrived.	Cleared out.
English	505	526	Bremen	43	14
Danish	336	279	French	22	124
East Friesland	274		Italy	2	10
Dutch	261	474	Spain	2	47
Swedish	186	129	America	1	1
Prussian	86	42	Tripoli		1

In 1806, however, the number of ships that arrived was only 377, and those that cleared out 408.

The following are the principal articles which were manufactured in Dantzic, woollen stuffs, cloths, gold and silver stuffs, lace, ribbands, white and black soap, starch, gunpowder, paper, cutlery goods, tobacco, saltpetre, Morocco leather of all colours, shoes and slippers; red and yellow boots for children; tanned leather; varnish made of amber, gum sandarach and oil; musical instruments; furs which are dyed in a very superior manner; different liqueurs, and a kind of spruce beer known in England by the name of black beer. The total amount of the manufactures of Dantzic in 1804, was 774,569 German crowns, one of which is equal to 3 francs.

Among the objects which are deserving of notice in the environs of Dantzic, we may mention the Abbey of Oliva, celebrated by the peace which was concluded there in 1660. The apartment and the table where the act was signed are still to be seen; and this great event is recorded on a tablet of marble. The chapel of the Virgin, and that of the Abbé Rybinsky, in the form of an ancient round temple, are greatly admired.

Although more than 40,000 of the inhabitants of Dantzic were carried off by the plague in 1709, yet in 1730, the population was reckoned to be 200,000. In 1752 the number of deaths are stated at 1846 by Busching, which calculating at 1 in 50, gives a population of 92,300. In 1774, the population was estimated at 50,000. In 1783, the number of births was 1118, and the deaths 1683, which gives a population of 84,150, reckoning at the rate of 1 in 50. In 1802, the population was 47,000, exclusive of the garrison. In 1804, it was reckoned at 60,097, including the garrison.

The various political revolutions which this city has sustained will be related in another part of our work. In 1806, when it was besieged by the French under Marshal Lefebvre, the whole of the suburbs were burned down, and 3000 buildings considerably damaged. The loss on this occasion was estimated at one million and a half sterling. During the siege which it underwent during the last year (1813) from the allied army, it has also received very considerable injury; and even if the independence of Europe and the freedom of commerce are completely established, a series of years must elapse before Dantzic recovers from the severe losses which have been so cruelly inflicted upon her. East Long. by astronomical observations, 18° 38′ 30″, North Lat. 54° 20′ 48″. (π)

DANUBE, or DONAU, is the greatest river in Germany, whether we consider its length, its depth, or its width, and is the largest of all the rivers in Europe except the Wolga. Without counting its windings, the length of its course has been calculated at 1620 miles. The Danube has its origin near the small town of Doneschingen, or Donaueschingen, in Suabia, in the court-yard of the palace of the princes of Furstenberg. Some small rills of water spring from the ground, and form a basin of water about 30 feet square, from which issues a brook, that afterwards falls into the united rivers of Bribach and Brege.* After passing by the towns of Ulm, Newburg, Ratisbon, Straubing, Passau, Linz, Crems, Vienna, Presburg, Buda, Belgrade, and Widdin, the Danube discharges itself, by several mouths, into the Black Sea, in the province of Bessarabia.

From several towns on the Danube, but particularly from Ulm and Ratisbon, there set out, every Sunday, a number of boats, which convey goods and passengers to Vienna. At Ratisbon, there are 16 or 17 licensed proprietors of boats, who perform this duty in rotation.

From its source, till it reaches Ratisbon, the Danube runs in a north-easterly direction. After having quitted the vineyard and fields of Ratisbon, and the beautiful ruins of Donaustauff, the boat generally casts anchor near Pforter, opposite to Worth. The next morning it passes the bridge of Straubing, which is reckoned the most dangerous part of the voyage. The church near Poyen seems as if it were about to fall upon the heads of the passengers, and the small islands which here occur, and the gloomy forests of pine, give a new character to the landscape. The banks of the river rise like an amphitheatre, till the ruins of the castle of Natternberg come in sight. At Deckendorff the Danube receives the waters of the Iser, and at Vilshofen it is crossed by a wooden bridge of 16 arches, and is joined by the Vils, famous for its trouts and salmon. The Danube now assumes a melancholy and picturesque character, which continues till it reaches Passau. The windings of its course are constantly interrupted by rocks, both above and below the surface, which occasion a great noise, and require all the skill of the pilot to avoid them. Passau is situated upon an isthmus, formed by the Danube and the Inn, which now discharges its water into the former. The Inn is about 100 feet broader than the Danube at their confluence,† and from this cause the Swiss writers have contended that the Inn is the finest river, and consequently that the Danube has its origin in Switzerland. Here is a splendid view from the citadel of Passau, and the town is celebrated for having afforded to Salvator Rosa some of the finest subjects for his pencil. The Danube now becomes more rapid, and, for a considerable distance below Passau, its banks are high hills and rocks covered with box-wood and spruce fir.

Behind Passau, the Danube forms some delightful little islands. The small villa of Krempenstein has a picturesque situation upon the summit of a mountain; and, in turning from the north to the south, a sudden view is obtained of the chateau of Furstenstein, on a height upon the right bank. The boat now passes at the foot of a rock adorned with a small chapel, which forms the frontier between the territory of Passau and that of Austria. Hafnerzell, as its name imports, is inhabited only by potters, who supply several countries with crucibles of black lead, and even export them to the Indies. At a considerable distance on the left is seen a fine old tower, not far from Engelhardzell or Ingelhartzeil. At this town is the first Austrian custom-house, where a rigorous examination of the boats takes place. The two remarkable chateaus of Reinach and Marsbach are deserving of notice, and on the left is an insulated dungeon, celebrated in the romances of Mrs Radcliffe. The situation of Neuhaus and Aschau are greatly admired. Towards Linz, the Danube runs almost due east, through a flat country, with high mountains in the distance, clothed with wood. The beautiful situation of Linz; its fine bridge of 20 wide arches; the magnificent church of Bostelfeld, the appearance of Ufer-Linz; the vineyards; the cultivated fields; the alps of Salzbourg, in the distance, covered with snow, form a spectacle which is reckoned one of the finest in Europe. The beautiful town of Ens now appears on the right hand, and the rivers Trauen and Ens throw themselves into the Danube. The course of the river is now very irregular, and sometimes winds to the south, and at other times to the north-east. Sometimes it resembles a sea, with scarcely any land in sight, and at other times it is broken into small streams by numerous islands. The ruins of Speilberg attract the traveller's notice, and after having passed the beautiful chateau of Waldsee, that of Greyn next appears, wildly situated upon rugged rocks. The noise of the breakers at its foot has procured for it the name of Greynes-Schwall. A dreadful noise, like that of thunder, soon announces the famous waterfall and whirlpool of Stroudel. It has frequently proved fatal to boats drawn into its vortex; but if the boatmen are not intoxicated, and the water is not too low, there is no risk of any accident. This whirlpool is produced by a rugged island of rock, which rises in the middle of the river. The boats pass to the left of this island, above a rocky bottom, and where the rocks and heaps of stones raise themselves out of the water. The Empress Maria Theresa expended considerable sums of money in improving the navigation of this part of the Danube. About a quarter of a league farther is the whirlpool of Wirbel, still more dangerous. The impetuous waves of the Danube, which here dash against an inclined promontory of rock, are driven back in rapid circles across the narrow strait confined between two lofty banks. Before they enter, and after they quit these two whirlpools, the boatmen regularly say their prayers.

The small village of Ins, the chateau of Besenberg, and another chateau in ruins, form a picturesque triangle. Maria Taferl, who drew more than 10,000 foreign pilgrims annually, crowns the summit of an insulated rock. The Abbey of Melk has a grand appearance, with its towers and walls; and beyond this place, the country grows more and more wild. A natural wall of rocks, called the *Devil's Wall,* prevents the sun from being seen; and above this wall are situated Spietz, and its rich vineyards, one of which, under the name of Spitzam Platz, produces annually a thousand muids of wine. The traveller now approaches the superb and romantic ruins of the chateau of Thierstein, the prison of Richard Cœur de Lion, the brave king of England. At the sight of this the boatmen cry out *O Richard! O mon Roi!* and bless the memory of his faithful servant. Above the chateau there is a large convent. At Stein, which is on the left of the river, there is a wooden bridge of 25 wide arches. Behind the town of Mautern appears, upon a high mountain, the vast abbey of Gottwich, celebrated for its fine buildings, its ancient manuscripts, and the learning and hospitality of its monks. Kloster-Neuburg next appears, and

* M. Nicolai maintains that the Danube has its origin at Saint-Georgen, a convent and manufacturing town in the Black Forest.

† The breadth of the Inn is here 890 feet, and that of the Danube only 780.

Daphne ‖ Dar-fur.

the mountain of Leopoldsperg, from which there is a splendid view of Vienna in all its extent. The passengers land at Nussdorff, where there is a custom-house.

After passing Vienna, the Danube flows to the south-east, forming an immense number of islands, one of which, the island of Lobau, is famous for the scene of the bloody battles which terminated the coalition of 1809. The Danube then passes Presburg, and enters Hungary below the town of Haimburg. Its course is a little to the south-east from Presburg to Comorn; but it afterwards runs almost due east to Waitxen, beyond which it runs directly south nearly to its junction with the Drave. It then moves in a south-east direction towards Belgrade, Semendria, and Widdin. After resuming its easterly course, it forms the limits between Wallachia and Bulgaria, and at last discharges itself by several channels into the Black Sea. Between Buda and Belgrade it is so deep, that it could be navigated by men of war; but on account of the cataracts, it is not navigable to the Black Sea.

The water of the Danube is generally of a yellow and clayey colour, and is impregnated with argillaceous particles. It contains a great number of different species of fish, which become very fat and delicate, from the quantity of plants and seeds which are brought down by the mountain torrents.

For fuller details respecting the subject of the Danube, the reader may consult the following books: *L'Antiquaire du Danube*, an old work; Hess *Voyages en Allemagne*, tom. iii.; Arndt *Beuchstücke aus einer Reiss nach Wien*, vol. i. Leipzig, 1801; but particularly *Donau-Reise von Regensburg bis Wien, mit Angabe aller Ortschaften und ihrer Merkwurdigkeiten.* Ratisbon, 1802. (π)

DAPHNE, a genus of plants of the class Monandria, and order Monogynia. See Botany, p. 203.

DARDANA, or the town of the Dardanelles, is a town of Turkey, in the province of Romelia, situated at the foot of the castle of the Dardanelles. It is about a mile and a half in circuit. Cotton stuffs are manufactured here, and also sail-cloth. A kind of earthen ware is made in great quantities, to the amount of 16,000 crowns annually. Small vessels are built here, and wax, oil, cotton and wine are exported. Dr Clarke informs us, that in the recess of a small bay, before reaching the town, is the best situation for viewing the part of the strait, where Xerxes is supposed to have passed with his armies; and from this place the two castles have a very striking appearance. The wine of the Dardanelles, which is of a red colour like that of Tenedos, is preferable to the latter, and keeps to a great age; and after being kept 20 or 30 years, it loses its colour but not its strength. It is called the *Vino della Lege*, and is made chiefly by Jews. It is sent to Constantinople, Smyrna, Aleppo, and even to England. Its price is about two-pence a bottle. In 1766, this town received great injury from an earthquake. The number of houses is 1200, among which 200 are Greek, 100 Armenian, and 50 Jewish. East Long. of the old castle 26° 19′ 30″, N. Lat. 40° 9′. See Clarke's *Travels*, vol. ii. p. 64. (*w*)

DAR-FUR,* a country in the interior of Africa, and situated toward the east of what is generally called the central division of that quarter of the globe, extends from 11° to 15° 0′ N. Lat. and from 25° 40′ to 29° 20′ E. Long. The people of this country possess no written documents; and little dependence can be placed upon what they relate of their early history. The people of Dageou, a country more towards the west, and who are said to have come from the vicinity of Tunis, conquered the country now called Fûr, but were at length exhausted by intestine wars. The present race of kings then succeeded, supposed to have been of Moorish origin, and to have been driven from the north by the Arabs. Some of the earlier princes are still spoken of by the names Solyman, Mohammed, &c.; but very contradictory accounts are given of the genealogy and succession of the different monarchs. The reign of Solyman is commonly mentioned as the æra, when Islamism was introduced into the country; and Mr Browne is inclined to place the reign of that prince between the years 1650 and 1680.

Government.

The monarch is completely despotic; and has no council to controul or assist him in his office. He considers the soil and its productions as his personal property, and the people as his slaves. He has no restraint but the Koran, though, in cases of extreme oppression, the Fûkkara, or ecclesiastics, express their disapprobation sometimes with considerable boldness, but they possess no regular authority, and the prince fears nothing so much as any alienation in the minds of the soldiery. In the provinces, his power is delegated to officers generally called Meleks, who possess an authority equally arbitrary. If a province has been recently conquered, or annexed to the kingdom, the chief is permitted to retain the title of Sultan, but owes his appointment and renders tribute to the Sultan of Fûr. The crown is properly hereditary, descending to the oldest son, or in default of heirs male, to the oldest brother of the deceased monarch; but this received rule of succession is frequently set aside, and the strongest claimant becomes the sovereign. In this manner Abd-el-rachman had gained possession of the supreme power in the year 1787; but in 1795, when Mr Browne penetrated into his dominions, his severe regulations and personal avarice had excited the discontent of his subjects, and particularly of the soldiery, to such a degree, as threatened a speedy termination to his reign. When the sovereign appears in public, all the spectators, as he passes, are obliged to be barefooted, to fall on their knees, and if they are his subjects, to bow themselves to the earth. Even the Meleks, when they approach the throne, are required to creep on their hands and knees. On a great day of public audience, described by Mr Browne, the king was seated on his throne under a lofty canopy composed of various Syrian and Indian stuffs of different patterns, hung loosely on a light frame of wood. The Meleks were seated at some distance on the right and left, and behind them a line of guards, with a small piece of copper, and a black ostrich feather in the front of their caps, a spear in the right hand, and a target of the hide of the hippopotamus on the opposite arm, while their dress consisted only of a cotton shirt of the manufacture of the country. Behind the throne were 14 or 15 eunuchs, splendidly but clumsily clothed in habiliments of cloth or silk; and the space in front was filled with petitioners and spectators to the number of more than fifteen hundred. A band of hired encomiasts stood on the monarch's left hand, crying out, as loud as possible, during the whole ceremony; "See the buffalo, the offspring of a buffalo, a bull of bulls, the elephant of superior strength, the powerful Sultan Abd-el-rachmân-el-rashed! May God prolong thy life! O! Master—may God assist thee and render thee victorious!"

Religion.

The religion of the country is that of Mahomet, and,

* *Dar*, signifies a kingdom or district and *Fûr*, a deer, a name supposed to have been given to the natives by the Mahomedan conquerors, indicating the rapidity of their flight.

Dar-fur.

next in rank to those who fill the offices of government, are the Faquis or learned men, that is, the priests. Some of them have been educated at Cairo, but the great part, in the schools of their own country, and are ignorant of every thing except the Koran. The whole nation, like most of the people in the north of Africa, except the Egyptians, is of the sect of the Imam Malek, and are remarkably intolerant towards the Franks. Many idols are still worshipped by the women in the Sultan's haram; and the mountaineers offer sacrifices to the deities of the mountains when they are in want of rain. At the great annual festival, they are said to practise many superstitions, and even to put to death a boy and girl as a sacrifice.

Revenues.

The revenues of the sovereign of Dar-fûr are derived from a variety of sources, which altogether produce a very great amount. On all merchandise imported, he receives a duty of nearly one-tenth; upon the slaves exported, there is demanded a kind of tax, or rather douceur, as the price of exemption from scrutiny, generally at the rate of more than L. 100 for every thousand of slaves. He receives also one-tenth of all the slaves which are procured by predatory excursions from the neighbouring districts by his own subjects. Every village pays annually a certain sum in corn; and he is entitled to the tenth of the sheep, goats, oxen, and camels, and to all the male horses, which are reared by his tributary Arab subjects. All fines for misdemeanours, which the prince himself has the power of imposing, go to the royal treasury; and every person who engages in a judicial proceeding before him, must offer a present according to his rank and property. A considerable income arises from the presents daily received from all the great personages of the kingdom, from the merchants who come to the country for purposes of traffic, and from those who solicit offices under government; and particularly at the great festival called *the leathering of the kettle drum*, there is a general offering of presents to the sovereign from all the principal people, and almost every householder in every town and village of the kingdom, on which occasion a Melek has been known to give to the value of L. 200 sterling. In addition to all these sources of wealth, the sovereign possesses lands of his own, cultivated by his slaves, for the supply of his household; and is also the chief merchant in the country, sending quantities of his own goods with every caravan to Egypt, and employing his slaves to trade in the adjacent countries with the merchandise brought from that country.

Commerce.

The principal trade of Dar-fûr is carried on with the country of Egypt, by means of a caravan to Grand Cairo. The motions of this caravan are extremely uncertain; sometimes two or more of them arriving in Egypt in the course of the same year, and sometimes none appearing for the space of two or three years. This irregularity is owing to the changes in the governments of the two countries, the caprices of their sovereigns, and the power of the Arabs who infest the roads. Hence the departure of a caravan from Dar-fûr forms a very important event; engages the attention of the whole country for a considerable time, and becomes even a kind of chronological epocha. Two thousand camels, and a thousand head of slaves, are accounted a large caravan, from Dar-fûr to Egypt; but on their return they seldom amount to five hundred camels. The principal articles transported in these caravans are slaves, camels, ivory, ostrich feathers, gum, pimento, tamarinds, leather sacks, parroquets, guinea fowls, and white copper. The principal commodities brought back from Egypt are cotton cloths made in that country, Indian muslins and cottons, light French cloths, red caps of Barbary manufacture, silks, carpets, shoes of red leather, firearms, strait sword blades, copper, tin, brass and iron wire, writing-paper, soap of Syria, small looking-glasses, beads of various kinds, coffee, spices, and perfumes.

Agriculture.

During seven or eight months of the year, the face of the country is dry and sterile; but the rainy season, which prevails from the middle of June to the middle of September, suddenly invests the fields with a delightful verdure; and in general, the produce of the year depends upon the abundance of rain which falls during this period. The south-east wind brings the greatest quantity; the north and north-west breezes are cool and refreshing; the thick, hot, and sultry air comes from the south. A custom similar to what Herodotus relates of the ancient Egyptian kings, and to what is to this day practised in the empire of China, is observed by the Sultan of Darfûr, in honour of the labours of agriculture. As soon as the wet season commences, he goes out with his Meleks and attendants, and begins the labours of the field, by planting a few grains with his own hand. Few instruments are required in the operations of their husbandry. When the soil has been sufficiently softened by the rains, the cultivator and his assistants go out to the field with a kind of hoe; and, having made small holes with this instrument over all the ground, about two feet distant from each other, throw in the grain, and cover it with the foot. The general crop consists of millet, with a small quantity of wheat, sesamum, and a particular species of bean. In two months the millet, and in three the wheat is ready for the reaper. The process in harvest is equally simple with that of the seed-time. The women and slaves break off the ears with their hands, (leaving the straw to be afterwards removed,) and carry them away in baskets upon their heads. When these have been thrashed, (which is very awkwardly and incompletely done,) the grain is exposed to the sun till it become quite dry; and is then deposited in a hole made in the earth by way of granary, and covered over with chaff and earth. In the gardens are cultivated lentils, kidney beans, onions, garlick, melons, and cucumbers. Gourds and water melons grow wild in considerable abundance. There are few trees in the country, and those, which prevail most, are characterised by sharp thorns, and a solid imperishable fibre. The plane and sycamore sometimes appear; but they are both supposed to have been brought from Egypt. The tamarind grows to a considerable size, and bears large crops of fruit. The date trees are very rare, and their fruit dry and diminutive. There are several small shrubs, some of which yield fruit scarcely worth gathering. Rice grows wild in some of the districts, but is of a very inferior quality, and is little used or esteemed. Tobacco is produced in abundance, and appears to be of native growth. Hemp is regularly cultivated, but is chiefly used as a narcotic and an aphrodisiac; and for this purpose is smoked or chewed in its crude state. Cayenne pepper is extremely common in one part of the country, and is generally used in the food of the natives.

Animals.

There are few *horses* in the country, and the natives pay little attention to the breed. Their best horses are bred in the country of Dongola, and by the Arabs to the east of the Nile. These are larger than the Egyptian breed, well formed, full of spirit, yet extremely tractable. The *asses* are similar to those of Great Britain, and are much used for riding, as few persons but the military, and those who are in immediate attendance at court, make use of horses. The only good asses are those which the merchants bring from Egypt; and one of these will sell at the value of one, two, or three slaves, according to the weight which he is able to bear. Numbers of *horned cattle* are reared in the vicinity of the rivers, and the beef, which is a constant article of food with the natives, is of good quality. Cows are numerous, but their milk is not palatable. The *camels* are of a very mixed breed, and are found of all colours and sizes. Those which are reared in the country of Dar-fur are remarkable for enduring thirst, but not capable of bearing great burthens. They are particularly subject to the mange, especially in winter; and their chief remedy is a kind of tar, procured from the seeds of the water melon. The milk of the camel is much esteemed, and the flesh, especially of the female, which is fattened for the purpose, is much used for food. There are two or three distinct breeds of *sheep*, but not materially differing from each other. Their wool is coarse, similar to hair, and apparently unfit for any manufacture. Their flesh is inferior to that of the Egyptian breed. The *goats* are more numerous than the sheep; their flesh is cheaper; and they grow to a larger size than those of Egypt. The *dogs* resemble those of Egypt. The common house *cat* is scarce, and is chiefly brought from the country. The beasts of prey are principally the lion, the leopard, the hyena, the wolf, the jackal, and the wild buffalo; but, excepting the hyena and jackal, they are not commonly seen within the cultivated parts of the empire. The latter are harmless, but their uncouth howlings are heard to a great distance. The former enter the villages at night in companies of six or eight, kill dogs or asses, drag off the dead carcases of camels or other animals, and are not much alarmed at the sight of a man, or the report of fire arms. The people of the country dig pits for them; and when one is entrapped, they stun him with clubs, or pierce him with spears. There are found also elephants in herds sometimes of several hundreds. They are smaller than those of Asia, and are hunted by the Arabs, who aim at them with spears, or make pits into which they fall. Their flesh is greatly esteemed as food, their fat as an unguent, and their hide as serviceable for many useful purposes. The wild buffaloes are hunted in like manner, and used as food. The hippopotamus is also hunted for his teeth, which are superior to ivory, and his hide, which makes excellent shields and whips. There are found also the camelopardalis, rhinoceros, crocodile, antelope, ostrich, civet cat, jerboa, and porcupine.

Wild beasts.

Birds.

Among the birds, the most remarkable are the *white headed vulture*, a bird of surprising strength, and said to be remarkably long-lived. They are very numerous in the inhabited districts; and carry off, in the day time, the carrion which the hyena has left during night. Near the extremity of each wing there is a strong sharp horny substance, resembling the spur of an old cock, which they use as a formidable instrument of attack. The *guinea fowl*, of great beauty, is found in abundance, and is carried as a profitable commodity to Cairo. There is no external distinction observable between the male and female of this bird; and their voice, when apparently elated, is very peculiar. *Green parroquets* fill the trees in the beginning of summer; and, being caught young, are tamed, and carried to Egypt, where they are taught a kind of speech, and sold at a high price. The other birds found in the country are, the quail, dotteral, pigeon, partridge, and owl. Fish of the same kinds as those of the Nile in Upper Egypt, are found in the river Ada, and are caught in wicker baskets. The natives have a method of drying them; but they are so offensive to the smell, as to be useless to any except themselves.

Fish

Reptiles and insects.

The *chameleon* abounds in Dar-fur, and is considered as an impure animal by the natives. Serpents, lizards, reptiles, and insects of various kinds are sufficiently common. The *scorpion* is of a small size, a brown hue, and not very malignant venom. Its sting is cured by the natives, by the immediate and renewed application of a bruised onion, till the pain subsides. The *white ant* is extremely destructive, eating through every thing within its reach. The *common bee* abounds, but no hives are in use, and the wild honey has a very unpleasant taste. Great quantities of *cochineal* are to be seen, but the natives apply it to no useful purpose. The *locust* of Arabia is very common, and is frequently roasted and eaten, particularly by the slaves. The mosquitoe is peculiarly troublesome in the rainy season.

Minerals and metals.

The rocks in Dar-fur consist chiefly of grey granite, and are used as mill-stones; but there is scarcely any stone suitable for building or convertible into lime. *Alabaster*, however, and various kinds of marble, are found within the limits of the empire. *Fossile salt* is not uncommon in a certain district; and there is a sufficient supply of *nitre*, of which, however, no use is made. *Sulphur* is brought by the Arabs from the south and west; and the hot springs, said to be found on the mountains called Gebel Marra, may be the effect of sulphureous vapours. The different metals are also said to exist towards the south and west. The *copper* is of the finest quality, resembling that of China, and appearing to contain a portion of zinc. *Iron* is found in abundance, but the natives have not the art of hardening it into steel. There is much *gold* in the countries on the east and west, but little is brought to Dar-fur; and there is little silver, lead, or tin, except what comes from Egypt.

Inhabitants.

Of the people of Dar-fur a great proportion are Arabs, many of whom lead a wandering life on the frontiers; and are in so unsettled and independent a state, as to be scarcely subservient to the purposes of the government, either in peace or war. Another portion consists of the people of Zeghawa, who once formed a separate nation, and who still speak a different dialect from the Furians. A third class comprehends the people of Dageou, who are also a distinct tribe, formerly the rulers of the country, but now subject to the sovereign of Fur. The natives of Kordofan, and of some other smaller kingdoms, are likewise dependant on the crown of Dar-fur; and a considerable portion of the inhabitants of the country, especially of one of the larger cities, viz. Cobbé, are properly foreigners, traders from Egypt, and from the countries on the Bahr-el-Abiad, or western branch of the Nile, viz. Dongola, Mahas, &c. as far as Sennaar. These are supposed to have first opened the communication between Dar-fur and Egypt; and are described as daring, restless, and turbulent, full of enterprise, and indefatigable in commerce. They usually intermarry with each other, or with the Arabs, and are easily distinguishable from the natives of the country. They have a good stature and figure, often an agreeable and expressive countenance, an olive complexion, short, black, and curly, but not woolly hair, and a form of visage altogether more resembling the European than the African. The amount of the whole population cannot be estimated with any degree of precision. There are not more than eight or ten towns of any considerable extent, and the most populous of these does not

Dar-fur. contain above 6000 inhabitants. There are numerous villages; but the largest consist only of a few hundred souls. Two thousand men are accounted a large army; and from all these considerations, Mr Browne calculates the whole population of the empire as not exceeding 200,000.

Character. The people of Dar-fur are sufficiently cheerful in their dispositions, and have little of that gravity of manner, which Mahommedanism requires. They are remarkably addicted to drunkenness; but are unprovided with any other fermented liquor than bûza or merisi. In this liquor, (though prohibited by the Sultan, under pain of death, on account of the quarrels and bloodshed which often attend their excesses,) they often indulge from sun-rise to sun-set, till each individual has swallowed nearly two gallons; but it is said to possess a diuretic and diaphoretic quality, which prevents any injurious consequences to their health from such intemperance. They are noted for thieving, lying, fraud, and all the concomitants of these vices; so that in making a bargain, the parent and the child will mutually glory in deceiving each other; and no property is safe in any place unless the owner be stronger than the thief. They are libidinous to an extreme, are addicted even to incestuous intercourse; and practise their licentious indulgences almost in open day, without any restraint or decency. They are not much attentive to personal cleanliness; and rarely either comb their hair, or thoroughly wash their bodies. They are unacquainted with the use of soap, and are contented to polish the skin with unguents. They have, however, a method of cleaning their bodies, by means of a farinaceous paste, which is applied with butter to the skin, and rubbed continually till it become dry; an operation which is accounted one of the highest luxuries. They differ in their figure from the negroes of the coast of Guinea; their complexion is perfectly black, and their hair short and woolly, but sometimes eight or ten inches in length, which is esteemed a beauty. As soldiers, they are not famed for skill or courage; and in their campaigns, reliance is placed chiefly upon the Arabs, who accompany them, but who are rather tributaries than subjects to the Sultan.

Houses. The houses of the Furians are remarkably slight and simple in their structure. The walls are built of clay, which the more wealthy cover with a kind of plaster, and paint them white, red, or black. The roof consists of light beams laid horizontally from one side to the other, on which is spread a stratum of light wood or coarse mats; over these is laid a quantity of dried horses or camels' dung; and the whole is finished with a strong smooth coating of clay. Their apartments are of three kinds; the *donga*, generally about 20 feet by 12, having a door of a single plank secured by a padlock, and thus forming the repository of all their property; the *kournack*, usually larger than the last mentioned, without a door, slightly thatched with the straw of the maize, and appropriated, as the coolest place, to sleeping and the reception of company; the *sukteia*, of a round form, from 15 to 20 feet in diameter, and constructed like the preceding, and in this the women are lodged and the food prepared. A *rukkuba* is frequently added, which is nothing more than a place sheltered from the sun, where a company may sit and converse in the open air. A house, containing two of each of these three kinds of apartments, is considered as large and commodious, and fit for the use of the wealthier merchants; but the village houses have generally nothing more than one apartment, of the form of the *sukteia*. Every habitation is generally surrounded with a thick hedge of dried branches of the acacia and other thorny trees, in order to secure the cattle, and prevent the escape of the slaves; and the houses are separated from each other at such wide intervals, that often in an extent of two miles in a line, not more than 100 distinct inclosures are visible.

Food. The grain chiefly used by the Furians, is millet, which, when coarsely ground, is boiled in the form of polenta, and eaten with fresh or sour milk, or more frequently with a kind of sauce made of dried meat pounded in a mortar, and boiled with onions, &c. The grain is frequently eaten raw, and merely moistened with water, without either grinding or baking. It is also formed into thin cakes, called *kissery*, or sections; but, in whatever way it is used, the richer class generally cause it to undergo a slight fermentation before it be ground, which gives it a pleasanter taste, together with an inebriating and narcotic quality, and then form it into a kind of paste, which will keep a long time, and is prepared for use by the addition of a little water.

Manufactures. Some of the principal manufactures are strong coarse cotton cloths, called *tokeas*, which form the covering of the lower classes; and sacks for corn or water, made of leather, which they are very dextrous in depriving of the hair and tanning for the purpose. They also make a kind of earthen ware, which they have the art of glazing; and the Arabs weave wicker baskets of so close a texture, as to hold milk, water, buza, &c.

Coin. Nothing resembling current coin is to be found in the country; and all commerce is carried on by simple exchange. Sometimes, as a medium of exchange for articles of little value, they make use of small tin rings, beads, salt, &c.; and this last mentioned substance they procure by collecting and boiling the earth of those places, where horses, asses, camels, and other animals have been long stationary.

Women. The Furians take as many wives as they can support, but are not so watchful over the conduct of their women as the Egyptians, and most of the other Africans. They do not retire at the approach of strangers, but freely enter the houses even of the foreign traders, and make their purchases at their leisure. They perform most of the laborious offices, build the walls of the houses, prepare the soil for the seed, sow, reap the corn, grind and convert it into bread; and it is not uncommon to see a man on a journey mounted upon an ass, while his wife is on foot behind him, carrying, perhaps, a supply of provisions, or of culinary utensils; yet the husband is not despotic in the house, but the wife has her full weight in the domestic economy.

Miscellaneous customs, &c. The people of this country are fond of dancing, and men and women often take this amusement promiscuously. Each tribe has its appropriate dance, some of which are grave, others lascivious, and all of them consisting rather in violent efforts than in graceful attitudes. The diseases most commonly observed among the people of Dar-fur, are a kind of leprosy, which gives to the skin and hair a white colour; umbilical ruptures, hæmorrhoides, the guinea-worm, bilious complaints, and the small-pox. The old women are the regular physicians; but their remedies are chiefly charms and exorcisms, such as writing sentences of the Koran on a board, and washing them off with water, which is given to the patient to drink. Several vernacular dialects are spoken in the country, but the Arabic is generally understood; and the judicial proceedings are immediately translated from the one to the other by a public interpreter. Among the customs peculiar to this country

Darien. may be mentioned the two following:—At the accession of a new king, the carpets on which the several deceased sultans used to sit, are spread before him, and whatever of them he prefers, it is concluded, that his character will resemble that of its former possessor. There is observed an annual festival, called *geled-el-nahas*, or the leathering of the kettle-drum, already noticed, which continues eight or ten days in succession. During this time, every subject, unless he be an absolute mendicant, is expected to come forward with some offering to the monarch; who, on his part, keeps an open table, or rather kitchen, during the festival. There is, at the same period, a review of all the troops not on actual service, if review it can be called, where every man, who has or can procure a horse, mounts and shows himself at this national meeting. See Browne's *Travels in Africa, Egypt, and Syria.* (*q*)

DARIEN, is a province of the kingdom of Terra Firma, or Castile Del Oco. This kingdom is divided into three provinces, Panama, Darien, and Veregua, of which Darien is the most extensive. It is bounded on the north and south by the two seas, on the east by the gulf or river of Darien, and on the west by another part of the South Sea and the province of Veregua. Its limits are not accurately ascertained; according to the ex-jesuit Coleti, it is 100 leagues in length; but Alcedo and other well-informed authors say that it is only 68 leagues long. At the broadest part, it is about 50 leagues wide, north and south. The whole kingdom of Terra Firma, according to Ulloa, is 180 leagues from east to west; but if the windings of the coast are reckoned, it is 213 leagues. The breadth of the kingdom is the same as that of the Isthmus of Darien, which includes the whole province of Panama, and part of that of Darien.

Extent.

The province of Darien is mountainous and rugged; but there are in it several *Llanuras*, or plains, which are fertile, but deserted, uncultivated, and not very healthy. The only produce of these plains is a little cacao and tobacco, the quality of both of which is excellent. There are a great many rivers in Darien, some of which run into the North Sea, and some into the South. The principal of the former are the Darien and the Chape; of the latter the Peto and Caynuto. The Atrato, Darien, or Choco, takes its rise in the mountains of the province of Choco, from two lakes; its course is nearly strait from south to north for ninety-five leagues, when it enters the North Sea, collecting, as it runs, the waters of the Andageda, Quito, Litasa, Zipe, Torron, and Pequerto, and of the lake Luina, and other streams, so as to form a mouth upwards of five leagues broad, in the Gulf of Darien. This river is navigable for many leagues. Till within these few years the navigation of it was prohibited under pain of death, under the pretence that it would injure the provinces of the Nuevo Reyno, as they might be easily entered by it; but in reality to prevent the gold, which is very abundant near its source, from being carried away. According to Humboldt, the navigation of this river is now declared free, and in consequence of this, the fraudulent exportation of the gold of Choco has much increased, especially at those times when foreign vessels are permitted to bring negroes from Africa, and flour from Philadelphia. As the Darien takes its rise near the gold mines of Choco, its sands abound in gold. Near its entrance into the sea, there are a number of small islands. Its mouth lies in latitude 8° 2′ North. The Chape rises in the mountains near the valley of Pacora. In its course it makes many windings, which are called *randantes*. It is navigated by vessels without keels, called chatas, as far as Cruces. On its banks near its entrance into the North Sea, there are many forts, as its navigation is watched and guarded by the Spaniards with nearly as much jealousy and suspicion as that of the Darien. It abounds in alligators, and the musquitoes on its shores are particularly troublesome. There is also found in it an immense number of a very small fish, about the size of a pin, called *titics*, which are drawn out with a basket. The mouth of the Chape is in 9° 18′ North Latitude. Ulloa, in his passage up it, ascertained, that the greatest velocity of its stream was about a league an hour. Cruces, where it ceases to be navigable, is about five leagues from Panama.

Rivers.

Darien. Rivers.

A great difference is observed in the tides in the North and South Seas. Those tides which in the ports on the North Sea are reckoned irregular, are considered regular in the ports on the South Sea: when they cease to increase or decrease in the former, they both rise and fall in the latter, extending over the flats, and widening the channels. Ulloa, who notices this circumstance, declares himself unable to account for it; "all that can be said, is, that the isthmus separating the two seas, confines their waters, whereby each is subject to different laws."

Tides.

The mountains in the province of Darien belong to one of those three remarkable chains, which are noticed by Humboldt as proceeding from east to west, parallel to the equator. This chain extends by Popayan and Choco, on the west of the river Darien, towards the isthmus, where, on the banks of the Chape, it forms mountainous land about 1200 feet high.

Mountains.

The gold mines of Darien at one period were very abundant and profitable, affording metal of a much finer quality than those in the provinces of Vereguas and Panama; but it was found necessary to abandon most of them, in consequence of the revolt of the Indians, so that only a few remain on the frontiers, which yield a small quantity of gold. The gold mines at Choco, where the river Darien takes its rise, have already been noticed. The largest piece of gold ever found there weighed 25 pounds.

Gold mines.

The most fatal disorder which rages in Darien is the *vomito*: it rages frequently with great violence on both coasts of the Isthmus, but the causes are supposed by Humboldt to be very different. At Panama, the *vomito* is endemical. Here the tides are very strong, and throw up great quantities of marine plants; these being exposed to the heat of the sun, putrefy and infect the air; hence, at Panama, the shore is considered as the origin of infection. At Porto Bello, on the contrary, the putrid emanations proceed from the very great strength and luxuriancy of vegetation. Here the tides are scarcely perceptible. That this is the cause of the insalubrity of Porto Bello, is apparent from the following fact. Till within these few years, the forests which cover the interior of the isthmus, extended to the very gates of the town; since the environs have been cleared, the salubrity of the air has been greatly increased.

Diseases.

Both on the north and south coasts of Darien, there are two sorts of general winds; the one called *brisas*, (breezes,) which blow from the north-east; and the other called *vendebales*, which blow from the west and west-south-west. On the north coast, the former set in about the middle of November, but are not fixed and regular till the beginning or middle of December. On the south coast, the *brisas* are later. On both coasts, they continue to blow till the middle of May: they

Climate.

Darien.

then cease, and are succeeded by the *vendibales*, which, however, do not extend farther than 12 or $12\frac{1}{2}$ degrees of latitude, beyond which the *brisas* blow, with less steadiness and regularity, however. At the period when the brisas blow strongest, a very impetuous current sets into the Gulf of Darien; and on the contrary, while the *vendibales* blow, the current sets out of the Gulf with equal violence.

Darien was the first province in Terra Firma in which the Spaniards established themselves. It was conquered by Vasco Nunez de Balboa, and was the scene of many of the valorous enterprizes of Francisco Pizarro. The settlement of Darien, which is the residence of the governor, was the first that was made on the continent of America, having been founded in 1509; but owing to the badness of the climate, it has now dwindled away to a miserable hamlet, exposed to the constant invasions and attacks of the Indians.

Inhabitants.

The natives of Darien are not numerous: in 1747, they were supposed to amount to 5000 families. They are brave, hardy, patient of fatigue and pain, but cruel, stupid, and faithless. The Spaniards have made many attempts to reduce them to subjection, but in vain; nor have they succeeded better in their attempts to convert them to Christianity. They soon relapse into their idolatrous habits, and retire into their native mountains. They are very skilful in the use of the bow and arrow. The former are made of a strong and flexible kind of wood, called *choata*. Their arrows consist of a species of light cane; the point being formed of fish bones, or of the same kind of wood as the bows. Their principal and most favourite food is the flesh of monkeys, of which animals there are here a wonderful variety. They ferment maize and plantains, from which they make a kind of drink, called *mazato;* with this they are fond of intoxicating themselves. They are nearly naked, but are fond of ornaments, especially golden rings pendant from their nose. The women adorn their legs and arms with strings of coral, beads of glass, and of gold. They pay great deference and respect to their priests, who render their countenances singularly horrible and deformed, by painting their faces of different colours, and making incisions, into which they insert bitumen. They are almost at constant war with the Chocoes. Their enmity to each other is said to have originated in the circumstance of the Indians of Darien having put to death a Christian priest, who was held in great reverence by the Chocoes, about the end of the last century. Since that time, every Indian of Choco carries a skull of an Indian of Darien, whom he has killed in war, out of which he regularly drinks. In consequence of this unintermitted hostility, and of the ravages of the smallpox, the numbers of the Indians of Darien are much diminished. They bear towards the Spaniards, perhaps, a more deadly enmity than any other of the Indian race in South America. In 1719, they rose against them in a body, and committed dreadful cruelties. The war continued till 1740, when a treaty was agreed upon, by the terms of which the Indians were to admit missionaries among them: but their efforts and zeal were of no avail, and the Spaniards were so exasperated, and at the same time so apprehensive of them, that it was proposed to free the Indians of Choco from their tribute, on the condition that they would join in exterminating the Indians of Darien: this plan, however, was abandoned. In 1786, another attempt was made to subjugate them. The viceroy of Santa Fé dispatched a large force against them, which succeeded in forming different establishments and settlements, but these were soon abandoned, in consequence of the badness of the climate, and the ferocity of the natives.

Darien scheme.

The advantageous situation of this province communicating with the two seas, its natural fertility, but above all, the reputation of its gold mines, have induced foreigners, at different periods, to attempt establishing themselves in it. Of these attempts, the most remarkable is that which was made by Patterson, a Scotchman, towards the close of the 17th century. It is said that he was originally a Buccaneer; who afterwards became a clergyman, and under pretence of converting the Indians, visited the New World. He was undoubtedly a man of an original mind, and of a bold and enterprising disposition. He was the first projector of the Bank of England, and being defrauded of his just recompence by those who adopted his plans, he resolved to confine his future schemes to the benefit of his native country. On his original and ostensible design of establishing an East India trade in Scotland, he engrafted the secret and magnificent plan of forming an emporium on each side of the Isthmus of Darien, for the trade of the opposite continents. According to his idea, the manufactures of Europe were to be sent to the Gulf of Darien, and thence conveyed by land across the ridge of mountains that intersects the Isthmus, where they were to be exchanged for the produce of South America and of Asia; and thus, to use his own emphatic language, he would wrest the keys of the world from Spain. In order to attract encouragement and support, he proposed to render his settlement a free port, and to banish all distinction of party, religion, or nation. But Scotland was at this time very poor; and the difficulties arising from her poverty were increased by the opposition which the plan met with in England. An alarm, first excited by the East India Company, and the West India merchants, soon spread over the whole nation. Even the parliament addressed the king in a violent and absurd address, remarkable for narrow and illiberal views; and the king appearing to fall in with the clamour, the Indian Company, whom Patterson had succeeded in establishing, withdrew their subscription, and relinquished their designs. But Patterson himself was not to be easily intimidated; and the Scotch nation, indignant at the opposition which the plan had met with in England, avowedly because it would be beneficial to Scotland, immediately subscribed L.400,000. Besides this sum, L.300,000 was subscribed at Hamburgh, which, however, was withdrawn, in consequence of the threatening memorial presented by the English resident to the senate of that city. The Scotch, nevertheless, persisted in their scheme: five large vessels, laden with merchandise, military stores, and provisions, with a colony of 1200 persons, sailed for the Isthmus of Darien. King William, however, still opposed it: his policy and wish were to oppose the aggrandisement of the House of Bourbon; and to accomplish this, he wished to keep well with Spain. In the mean time, the fleet arrived in the Gulf of Darien; and the settlement was very judiciously formed at Acta, a place at an equal distance between Porto Bello and Carthagena. Here is a secure and capacious harbour, formed by a peninsula, which the colonists fortified, and named Fort St Andrew. To the settlement they gave the name of New Caledonia. Of the 1200 persons who had embarked, 300 were gentlemen, unaccustomed to labour, fatigue, or homely fare, and totally unacquainted with any of those arts which are indispensibly necessary in a *new* colony. These consequently were of little use; and even the peasants, habituated to a cold climate, were unequal to the fatigue of clearing the ground under a burning tropical sun. In addition to these untoward circumstances, their provisions were either improper for the climate, or soon exhausted. The cargoes of merchandize which they sent to the West India islands, were not properly adapted for that market. The infant colony was attacked by the Spaniards, and proclamations were issued at Jamaica, Barbadoes, and in the American plantations, prohibiting all succour or access to the Scotch at Darien, on the pretence that their settlement there was an infringement of the alliance between England and Spain. For eight months the colony bore up against these accumulated misfortunes and persecutions; but at the end of this period, those who survived were compelled, by disease and famine, to abandon their settlement, and return to Europe. Before this circumstance was known, two other expeditions sailed from Scotland; and the information of the abandonment of the first colony only served to rouse the Scotch nation to more determined perseverance in the plan. When the second expedition arrived, they found the huts burnt, and the forts demolished; famine and disease assailed them; they were attacked by the Spaniards from Panama, these they repulsed; but a larger force coming from Carthagena, obliged them to capitulate, on condition that they should embark with their effects for Europe; few, however, of these, or of the other two colonies, survived to return to Scotland. The Scotch nation, at this utter and irremediable failure of a scheme, from which they anticipated great wealth, were highly indignant: they endeavoured to extort from William an acknowledgment of the national right to Darien; and failing in this, they presented an address to him, to assemble the Scotch Parliament: when it did assemble, a resolution to assert the national right to their colony, was only prevented by adjournment, and ultimately by proroguing the Parliament: It was, however, soon necessary to reassemble and mollify it, in order to get the supplies for the army; and when it did meet again, some very popular and spirited resolutions were adopted on this subject. The Scotch nation were never afterwards thoroughly reconciled to King William, and even for many years subsequent to his death, the remembrance of the loss of Darien was preserved with resentment and regret. In this scheme, £200,000 had been sunk; and at least as much had been expended in the purchase of provisions for the colony: Many families were reduced to ruin, and few had escaped without the loss of a relative or friend. It is melancholy to reflect on the failure of this grand and noble design, especially when we consider that if the colony had been maintained only a few years longer, the succession war would have secured the Scotch in the firm possession of the country. Patterson, on his passage home, after the ruin of the first colony, was seized with lunacy, from which, however, he recovered. He lived many years afterwards, pitied, respected, and neglected. The famous Mr Law, who was a youth at the time of the expedition to Darien, acknowledged that he was induced to project his Mississippi scheme, from the rapidity with which he perceived the spirit of speculation communicate itself on this occasion.

It is rather a remarkable circumstance, that Patterson should have happened to select for the seat of his colony, the only point where it would be perfectly practicable to open a communication between the two seas. Ever since Vasco Nunez de Balboa crossed the isthmus in 1513, this scheme has been fondly cherished, and several places have been pointed out, where it was supposed it could be carried into execution.

Places for opening a communication between the two seas.

1. The river Chape has been pointed out: this river, as has been already mentioned, falls into the Atlantic, about eighteen leagues to the westward of Porto Bello, and is navigable as far as Cruces, within five leagues of Panama: but to this mode of communication there are two strong objections; in the first place, from the accounts of Ulloa and Humboldt, the navigation of the Chape is extremely difficult, dangerous, and slow; it is obstructed by *races*, or swift currents over the shallows, where vessels, even though built on purpose, cannot proceed for want of a sufficient quantity of water: in the second place, the distance between Panama and Porto Bello is not known, and the intervening country is remarkably mountainous. So imperfectly is the relative situation of these two places ascertained, that the French geographers contend that Panama lies on the east side of Porto Bello, and the Spaniards place it on the west side. Ulloa, from his bearings in sailing up the Chape, concluded that Panama was situated 31′ to the west of Porto Bello, while, according to Fidalgo, who formed his map of the isthmus from astronomical and trigonometrical operations, Panama lies 7′ to the east of Porto Bello. Humboldt, who took great pains to ascertain the practicability of this mode of communication, is of opinion that it could not be effected, except on a small scale, and by means of locks and tunnels. A modification of this plan has been proposed: about five leagues from the mouth of the Chape, it receives the river Trinidad, which is navigable to within thirty miles of Panama; and it is said this space is level, and might easily be cut through: but too little is actually known respecting this tract, to decide on the practicability of the plan.

2. To the north of the Chape is the grand lake of Nicaraguay, which stretches nearly from sea to sea, and falls into the Atlantic Ocean by a navigable river. In the time of Charles III. a proposal was made to effect a communication by means of this lake: but the coast of Nicaraguay is inaccessible to shipping during the months of August, September, and October, on account of thunder storms and dreadful rains; and during the months of January and February, on account of the violent winds from the north-east.

3. The Mandinga takes its rise in the mountains of Chape, and runs east till it enters the bay, to which it gives name: this bay commences about ten leagues to the eastward of Porto Bello, and penetrates into the isthmus to within about five leagues of the Pacific Ocean: from the mountain where it takes its rise, the river Chape also flows, which falls into the gulf of Panama. Little is known respecting the navigation of these rivers, or the nature of the intervening country; but the Buccaneers penetrated from sea to sea, in this direction, in 1679, and the navigation of the Mandinga is prohibited by the Spanish government, under pain of death.

4. But the most commodious spot is undoubtedly that pointed out by Humboldt, in the bay of Cupica: between it and the river Naipi, where it becomes navigable, there are only five or six leagues of a flat, level, country, and the river Naipi terminates in the river of Darien: in this direction only, is the chain of the Andes interrupted. Near the source of the Darien, in the province of Choco, a communication has actually been opened between the two seas, ever since the year 1788. In this province there is a small ravine, lying between

one of the branches of the river St John and the Quito, which falls into the Darien: in this ravine, the Rector of Arvita has caused his flock to cut a small canal, which is navigable in the rainy seasons, and by means of which canoes, laden with cacao, have passed from sea to sea. See Humboldt's *Political Essay on New Spain*; Ulloa's *Voyage to South America*; Alçedo's *Geographical and Historical Dictionary of America and the West Indies*. (w. s.)

DARIUS. See PERSIA.

DARLINGTON, a market and borough town of England, in the county of Durham, is situated on the side of a hill, gently sloping to the east, at the foot of which runs the river Skerne, which is crossed by a bridge of three arches, and which runs into the Tees. The town consist of several well built streets, diverging from a square, in which the markets are held; and it contains several good modern built houses and excellent inns. The principal public building in Darlington is the church, which stands at the south-west angle of the market-place, and which was erected in 1160, by Bishop Hugh Pudsey. It is a spacious edifice in the form of a cross. The tower and spire rise from its centre to the height of 180 feet; and the stone of which it is built is said to have come from Cockfield-fell, a distance of twelve miles. The tower rises from uniform arches supported by clustered pillars, and the arches of the naves and aisles are irregular. The west door is highly finished. In 1567, a grammar school was endowed by Queen Elizabeth out of the funds of Marshall's chantry. The school, and the building, which was once the bishop's palace, are situated near the banks of the river. The last of these buildings is now farmed from the bishop's housekeeper as a work-house for the poor.

There are several flourishing manufactures in this town. Tammies, moreens, and other woollen stuffs are fabricated in great quantities, and there is a thriving manufactory of linen goods, such as diapers, huckabacks, and checks. The cotton manufactory, which was lately introduced, is in a flourishing state. There is also in this town a mill for spinning wool. In the neighbourhood of Darlington, a mill was erected by John Kendrew, a native of the place, for grinding and polishing lenses or glasses for optical purposes. The same artist erected another mill for spinning hemp and flax. A respectable agricultural society, which distributes premiums, holds its meetings in this town, and has already contributed to the improvement of agriculture. A sulphureous spring, which has been found of use in scorbutic and other complaints, was discovered in 1803, and is now much frequented.

The following is the abstract of the population return for 1811 for the township of Darlington:

Inhabited houses	818
Families that occupy them	1205
Families employed in agriculture	143
Families employed in trade and manufacture	850
Families not included in these classes	212
Males	2351
Females	2708
Total population	5059

See Hutchinson's *History of Durham*, and Brayley and Britton's *Beauties of England aud Wales*, vol. v. p. 83, &c. (j)

DARMSTADT, a town of Germany, and capital of the Grand Duchy of Hesse Darmstadt, is beautifully situated in a fertile territory on a small river of the same name, and about three leagues from the eastern bank of the Rhine. The principal objects of curiosity in this town are the palace, which is a stately building; the hall of the emperors, the public library, the library of the grand duke, the buildings of the tribunals, the academy of music, the schools of the town and the garrison, the school of industry, the cabinet of natural history, which contains several remarkable fossil bones of a huge size, which served as pillars to a house at Kostheim; the opera house; the large building for military evolutions, which admits about 1500 men for the manual exercise, and has 16 stoves; the military school; the college; the gardens of the palace; the gardens of the Grand Duke at Bersungen and Kranichstein; the chateau and the mineral waters of Auerbach; and the large manufactory for harness and wheel-work. On the summit of a mountain, near the district called Bergstrasse, and not far from Heppenheim, is a column of granite about 33 feet long, known by the name of Riesensaule, or the Pillar of the Giants. An altar 14 feet in circumference stands very near it. This town was lately celebrated for a dye-work in the house of the orphans; but we are unable to ascertain whether or not it is still in existence. Darmstadt is the ordinary residence of the Grand Duke, who was a member of the Confederation of the Rhine. The fate of this town will depend on arrangements which will soon be made, in consequence of the recent dissolution of the Rhenish Confederation. Population about 12,000, or 13,000, according to Catteau. See Reichard's *Itineraire de Poche de L'Allemagne et de la Suisse*, Paris, 1809; Catteau's *Voyage en Allemand et en Suede*, vol. i. p. 229. See also CONFEDERATION of the Rhine. (π)

DART. See DEVONSHIRE.

DARTFORD, a market town of England, in the county of Kent, which derives its name from the ford of the river Darent, on which it is situated, in a narrow valley between two hills. It was called *Derent-ford* by the Saxons, and is spelt Tarenteford in Domesday-book. The town consists of a principal street, through which the high road passes, and of two smaller ones going off at right angles. The chief public buildings are the church, the place-house, and the bridge. The church, which stands in the north east part of the town, near the river, is a large building, consisting of a nave, chancel, and aisles, with a tower which is embattled at the north-west side. In the chancel, on the north side, is a mural monument of Sir John Spelman, who had the merit of first introducing the paper manufacture into Britain. He and his lady are exhibited as kneeling at a desk. In the church there are several slabs inlaid with brass, some of which are curious and deserving of attention. The place-house was formerly a nunnery, established by Edward III. in 1355. Henry VIII. fitted up the buildings as a palace. Its remains are of brick, and consist of a large embattled gateway, with some buildings in the south, which are now occupied as a farm house. From the many drains and foundations of wells that have been discovered, the building must have occupied a great extent of ground. The stone wall which enclosed the garden is still entire. The bridge was formerly very narrow and dangerous, but was widened about 30 years ago at the expence of the county. The old market house and shambles were taken down about the same time, and new buildings erected instead of them in a more convenient situation. Below the town there is a good wharf. The principal manufactures of Dartford are gunpowder and paper. On the site of a wheat and malt mill, about a mile

Dartmoor, Dartmouth.

above the bridge, Sir John Spelman erected a mill for writing paper, and the same place is now occupied by the gunpowder mills. The present paper mill, which is a short distance below it, was erected on the place where Geoffrey Box of Liege built, in 1590, what is supposed to have been the first mill in England for slitting iron bars into rods.

The following is an abstract of the population return for 1811, for the parish of Dartford:

Inhabited houses,	526
Families that occupy them,	732
Ditto employed in agriculture,	251
Ditto in trades and manufactures,	308
Ditto not included in these classes,	173
Males,	1599
Females,	1578
Total population in 1811,	3177

See Hasted's *History of Kent*; and Brayley's *Beauties of England and Wales*, vol. vii. p. 557—565. (*j*)

DARTMOOR. See Devonshire.

DARTMOUTH, a borough and sea-port town of England, in Devonshire, situated near the place where the river Dart discharges itself into the British Channel. Mr Gilpin describes the bay formed by the mouth of the river, as one of the most beautiful scenes on the coast. "Both the entrance of the Dart into it, and its exit to the sea, appear from many stations closed up by the folding of the banks; so that the bay has frequently the form of a lake, only furnished with shipping instead of boats. Its banks are its great beauty. They consist of lofty wooded hills, shelving down in all directions." The town itself has also a fine appearance when seen from the bay. The houses, embosomed in trees, appear on the slope of a craggy hill, stretching almost a mile along the water's edge. The dock-yards and quay project into the river; and the rocks on each side consist of a glossy slate of a purple hue, having plants and shrubs on their summits.

Dartmouth formerly consisted of three villages, Dartmouth, Clifton, and Hardness, which are now united by buildings. The streets are very irregular, some of them being so much higher than others, "that it is almost possible to shake hands from without with a person at the window of an attic story." The streets are disagreeably narrow, and the lower tier of houses often communicate, by means of steps, with those above. The principal street, which is spacious, fronts the quay, and is chiefly inhabited by merchants. There are three churches in this town, besides a dissenting meeting-house. St Clement's stands on a hill about a quarter of a mile from the town, and has a tower 70 feet high. There are also three charity schools for the education of the poor. At the south end of the town are the remains of an ancient castle, rising immediately above the water. It appears to have been circular, but not strong.

The harbour, the entrance of which is defended by a castle, and two platforms of cannon, is very secure, and is capable of holding 500 sail. The castle was probably erected in the time of Henry VII. It is not large, and has but a few cannon upon its walls, but is remarkable for its picturesque situation.

The trade of this town arises chiefly from the Newfoundland fishery, which furnishes employment to about 3000 men, and is carried on to a great extent. About 350 vessels are employed in this trade, both in catching the fish, and in carrying them, when cured, to foreign markets. They are taken principally to the ports in the Mediterranean, and the vessels bring home, wine, oil, fruit, and salt. A number of ships are also employed in the pilchard fishery. Ship-building is carried on to a considerable extent. To the north of Dartmouth harbour lies Torbay, the famous rendezvous of the British fleet during inclement weather. Distance of Dartmouth from London $203\frac{1}{2}$ miles.

Darwin.

The following is an abstract of the population return for 1811, for the parishes of St Petrox, St Saviour, and Townshall, which form the borough of Clifton Dartmouth, Hardness:

Inhabited houses	364
Families that occupy them	842
Do. employed in agriculture	93
Do. in trade and manufacture	468
Do. not included in these classes	281
Males	1464
Females	2131
Total population, in 1811	3595

See Polywhele's *History of Devonshire*; Dr Maton's *Tour through the Southern Counties*; and Britton and Brayley's *Beauties of England and Wales*, vol. iv. p. 127—131. (*j*)

DARWIN, Erasmus, an eminent philosopher and physician, was the son of Robert Darwin, Esq. a barrister, and was born on the 12th of December, 1731, at Elveston, or Elston, in Nottinghamshire, where the family had a seat. He went through the usual routine of grammar-school education, at Chesterfield, under the tuition of the Rev. Mr Burrows. While under this gentleman's care, he made a very great proficiency in the attainment of classical learning; and even at that early age, discovered some of that poetical genius, and evinced that thinking and philosophical mind, which gave him so much celebrity in future years. The mathematics seemed to have no allurements for him; and his knowledge of that science was never extensive. To mechanical knowledge he was partial, and, during the course of his life, invented several ingenious contrivances. In the year 1753-4, he removed to Edinburgh, where he studied medicine; and from that to St John's College, Cambridge, where he took his degree of M. B. in 1755; and in his Thesis on that occasion, maintained that the movements of the heart and arteries are immediately produced by the stimulus of the blood. While at Cambridge, he composed a poem on the death of Frederick, Prince of Wales: it was printed among the Cambridge collection of verses on that occasion; but the merits of this, as well as some other pieces of poetry, which he occasionally produced about this time, do not rise above mediocrity, though they are ingenious and respectable.

Having completed his studies, he went to Nottingham, with the intention of settling there as a physician; but not meeting with success, he removed to Lichfield in 1756. At this time he was twenty-four years of age, rather above the middle size, his form athletic, and inclined to corpulency, and his limbs too heavy for exact proportion. The traces of a severe small-pox; features and a countenance which, when they were not animated by pleasure, were rather saturnine than sprightly; a stoop in the shoulders, and the then professional appendage, a full-bottomed wig, gave him, at that early period of life, an appearance of nearly twice the years he bore. Florid health, and earnest good humour, a cheering smile on entering a room, and on first accosting his friends, rendered in his youth that exterior agreeable, to which beauty and symmetry had not been propitious.

Darwin.

Soon after the arrival of Dr Darwin at Lichfield, his skill and discernment as a physician were put to the test. Being sent for to a young gentleman of family and consequence in the neighbourhood, who lay sick of a dangerous fever, and whose case had been pronounced hopeless by a celebrated physician, that had for many years possessed the business and confidence of the Lichfield neighbourhood; he, by a reverse and novel course of treatment, gave his dying patient back to a fond and despairing mother, with renewed existence and renovated health. This was the foundation of his prosperity; and this successful attempt gave him so high a degree of reputation at Lichfield and the neighbouring towns and villages, that his competitor finding himself neglected, and his reputation eclipsed by his youthful and ingenious rival, gave up the contest, and left the place. From that time his practice became very extensive; and his future efforts were attended by success equal to his first fortunate exertion.

In the year 1757, he married Miss Howard of the Close of Lichfield; a young lady, who, though only eighteen, possessed a mind of a very superior cast: a strong understanding; a taste for the works of imagination; ingenuous sweetness; delicacy, animated by sprightliness, and sustained by fortitude, were the qualifications which rendered her a proper and fascinating companion to a man of talents so illustrious. To her he could commit the important task of rendering his children's minds fit to receive the seeds of knowledge and of science, with confidence. But upon her youth, and a too delicate constitution, her having children in quick succession during the first five years after her marriage, had probably a baneful effect. Dr Darwin exerted all his skill and attention for the preservation of her valuable life: for thirteen years he was successful; and during that time she had five children, two of whom died in their infancy. Three, Erasmus, Charles, and Robert, were left to mourn her loss, and were distinguished instances of the importance of right principles being early instilled into the youthful mind. The first was an eminent attorney at Derby. To a most engaging disposition he united considerable talents; but his modest, diffident, and retired habits, had a tendency to increase his naturally indolent, procrastinating, and perhaps melancholy disposition, to such a degree, that the fatigue of attending his business wrought so powerfully upon his mind, that he voluntarily put a period to his career in the flower of his age.

Charles was born at Lichfield, in the year 1758. After receiving a preparatory education, he was sent to Christ-church College, Oxford, where he remained some time. From that place he removed to Edinburgh, where he studied medicine, and obtained the first prize medal offered by the Esculapian Society for the best essay. The subject was, the best means of distinguishing pus from mucus. In this paper, he states, "as the result of numerous experiments, when one wishes to examine the matter expectorated by his patient, let him dissolve a portion of it in vitriolic acid, and another portion of it in caustic alkaline lixivium, and then add pure water to both solutions. If there is a precipitation in each solution, it is clear the expectorated matter is pus; if there is no precipitation, the matter is simply mucus." He died at Edinburgh on the 15th May 1778. He left behind him an unfinished account of the retrograde motions of the absorbent vessels of animal bodies in some diseases, in Latin; a translation of which, together with the Dissertation for which he obtained the medal, were published by his father after his death. Robert settled as a physician at Shrewsbury, where he still remains, eminent as a professional man, and respected as a gentleman.

Dr Darwin's house during his residence in Lichfield, was the resort of a knot of philosophic friends, who frequently met in social converse. Among those may be enumerated Mr Watt, Mr Boulton, Mr Michel the astronomer, Mr Edgeworth, Mr Day, Sir Brooke Boothby, and Miss Seward. It is singular, that though Dr Johnson frequently visited his daughter-in-law, Miss Lucy Porter, at his native place, Lichfield, he and Dr Darwin had but one or two interviews; and that a mutual and strong dislike subsisted between them. Perhaps Dr Darwin's scepticism, in what Dr Johnson thought orthodox religion, supplies an easy solution of the cause of this enstrangement.

In the year 1781, Dr Darwin married a second wife, Mrs Pole, the widow of Colonel Pole, of Radburn, Derbyshire. This lady he had first seen in 1778, when she had brought her children, who were indisposed, to be under his care. While Mrs Pole remained with her children at the Doctor's house, her external accomplishments and internal qualifications inspired her philosophic host's admiration, and secured his esteem. In 1780, Colonel Pole died; and an opportunity was thus afforded the doctor of disclosing an affection, which he had long entertained, but which he was obliged to confine within his own breast. His addresses were accepted; and very soon after he left Lichfield and removed to Derby, where he resided about twenty years. His reputation, and the unlimited confidence of the public, followed him thither; and he once more became a happy husband, with a second family of children springing up fast around him. In the year 1801, he removed from Derby to the Priory, an estate which his son Erasmus, whose unfortunate catastrophe we have already noticed, had bought, and left to his father, who took a great pleasure in improving it. But, alas! his residence there was destined to be of no long continuance. He was subject to inflammation in his lungs, and had a serious attack in the spring of the year in which he left Derby. During these sudden and alarming disorders, he always applied the lancet, instantly and freely; and frequently rose in the middle of the night and bled himself. On the 10th of April 1802, he had a serious attack of this disorder, and at the same time a shivering fit. His surgeon took 25oz. of blood from him at different times on that day; and he so far recovered as to appear quite well, and walked and talked with his friends as usual. On Saturday the 18th of April, he rose at six in the morning, his common practice; and wrote several letters. But he had written no more than one page of a very sprightly one to Mr Edgeworth, describing, in a serene and happy manner, the Priory, and the alterations he intended making there, when he was seized with a shivering fit. He immediately rang the bell, ordered a quantity of butter-milk (which it was his custom to drink every morning) and desired Mrs Darwin to be sent to him. She immediately came accompanied by one of her daughters—they saw him shivering and pale; and though for a little he seemed to recover, he soon fainted, and expired between eight and nine o'clock, in the 71st year of his age. His body was opened, but no traces of a peculiar disorder was found; and the state of the viscera, indicated a much more protracted existence. He left a widow and six children, well provided for, all of whom are now living.

In his person, Dr Darwin was gross and corpulent, and unwieldy in his appearance, owing to a slight lameness, caused by an incurable weakness, proceeding from an accident which befel him at Lichfield, of breaking the patella of his knee. He stammered exceedingly, and his tongue, seemingly too large for his mouth, made it difficult for any but those who were accustomed to his society to understand him; and he could not bear to have his words anticipated. But whatever he said, whether gravely or in jest, was always worth waiting for; and the intelligence and benevolence with which his features were lighted up in conversation, did away every unpleasant sensation which might have been excited by any apparent deformity. His great benevolence of disposition was peculiarly conspicuous in his care of brute animals, and in the prevention of the exercise of cruelty towards them, and even to insects. His general manners were gentle, his temper cheerful, though sometimes hasty. He expressed his anger with vehemence, especially at any example of inhumanity or injustice. He became, in early life, sore upon opposition, whether in conduct or argument, and always revenged it by sarcasm of very keen edge. Nor was he less impatient of the sallies of egotism and vanity, and he seldom failed to present their caricature in jocose but wounding irony. No man exacted a less tribute of applause in conversation, though he was perhaps on some occasions too little accommodating to characters and circumstances. He possessed an ardent mind, was fond of admiration, and open to flattery. He was a warm friend to many. Modest merit found in him a fostering protection; truth and liberty, a strenuous and able advocate. Vice, and war, and oppression, a steady and indignant opposer.

The doctor carried his scepticism of human truth so far, that he often disregarded the accounts his patients gave of themselves, and rather chose to collect his information by indirect inquiry, and by cross examining them, than from their voluntary testimony. He avowed a conviction of the pernicious effects of all vinous fluids on the human system, and totally abstained from malt liquor, wine, and spirits of all sorts; and by his precepts upon this subject, and his correspondent example, he so diminished their use, that intemperance was scarcely known in the circle in which he moved during his life, nor since his death has it again prevailed. Acid fruits with sugar, all sorts of creams, with butter, were his luxuries, of which he partook in great quantities, and always ate plentifully of animal food. He was not attached to any peculiar profession of faith, or to the dogmas of any particular church. But however sceptical he might be in his religious belief, he was a warm friend to liberty of conscience, an indignant enemy to religious persecution, and perhaps on this account be called a deist or an atheist; but there are many passages in his works, where very fine religious sentiments are expressed. He, however, exhibited in his conduct, what is more beneficial to the world at large, than the tenacious adherence to any speculative opinions,—firm integrity, and a benevolent heart. Professional generosity distinguished his medical practice. Diligently did he attend to the health of the poor at Lichfield and Derby, supplied their necessities by food, and every kind of charitable assistance. In each of these towns, *his* was the cheerful board of almost open-house hospitality, without extravagance or parade, ever deeming the first unjust, and the latter unmanly. Generosity, wit, and science, were his household gods.

To the many rich endowments which nature bestowed upon Dr Darwin, may be added strong passions, and a lively and highly poetic imagination. He did not come forward very early as an acknowledged poet. The effusions of his early muse, were occasionally sent to one or another of the monthly publications, but without his name, conceiving, from the examples of Akenside and Armstrong, that the reputation he might acquire by his poetry, would operate as a bar to his advancement in the practice of medicine. His *Botanic Garden*, the first of his poems to which he put his name, was not published until the year 1791, when his medical fame was so well established, as to make it safe for him to indulge his taste in any way he should chuse. This poem consists of two parts. The first contains the economy of vegetation; the second the loves of the plants. Each is enriched by a number of philosophical notes, stating a great variety of theories and experiments in botany, chemistry, electricity, mechanics, and in the various species of air. They also contain explanations of every personified plant, its generic history, its local situation, and the nature of the soil and climate in which it is indigenous, its botanic and its common name. The general strain of this work is flowing and majestic. By an inversion of all custom, Dr Darwin published the second volume of this poem first, giving as a reason in an advertisement, that the appearance of the first part had been deferred till another year, for the purpose of repeating some experiments in vegetation. But the real cause was the consciousness he entertained, that the second part of his work would be more on a level than the first to the comprehension, more congenial to the taste of the superficial reader, from its being much less abstract and metaphysical, while it possessed more than sufficient poetic matter to entertain and charm the enlightened and judicious few. The novelty of the design, and the brilliancy of the diction, full of figurative expressions, in which every thing was personified, rendered the poem for some years extremely popular. But the fame which it acquired has in a great degree subsided. Some able critics are unwilling to concede to Dr Darwin the merit of originality in the manner and style of his versification, and maintain, that he closely imitated productions that appeared many years before the *Botanic Garden*. The sources from which he is accused of having drawn copiously, are *Universal Beauty*, a philosophic poem by Henry Brooke, 1735, in 24 vols. folio, and a Latin poem by De la Croix, entitled, *Connubia Florum*. The plan of the *Botanic Garden* is certainly like that of the latter, and there are many passages in it very similar in their cast and expression to the former. It is possible that Dr Darwin might have seen these works, and that his plan might have been formed in part from them; but this does not derogate from his merit in producing a poem, in which no writer has so successfully attempted the combination of philosophy with poetry.

Our author's next work was his *Zoonomia, or the Laws of Organic Life*, 4to. The first volume was published in 1794, and the second in 1796. The purpose of this work, the gathered wisdom of three-and-twenty years, was to reform, or entirely new model, the whole system of medicine; professing no less than to account for the manner in which man, animals, and vegetables are formed. It was his opinion that they all took their origin from living filaments, susceptible of irritation, which is the agent that sets them in motion. Notwithstanding its numerous defects, the *Zoonomia* is a great work, and the production of a surprising genius. The vast variety of curious experiments which it contains, and the uncommon powers of ingenious combinations, which it every where displays, render it an exhaustless repository of interesting facts, important to the health and comfort of mankind. It has, however, ceased to be popular: its doctrines are not always infallible; but some of its speculations have been since verified by the great discoveries made in chemistry.*

About the year 1795, Dr Darwin published a small Tract, in 4to, on female education. It contains some good rules for promoting the health of growing children; but, on the whole, it is a meagre work, of little general interest, and it consequently attracted but little notice.

Early in 1800, Dr Darwin published another large 4to volume, entitled, *Phytologia, or the Philosophy of Agriculture and Gardening*. His conviction that vegetables are remote links in the chain of sentient existence, often hinted at in the notes to the *Botanic Garden*, is here avowed in a regular system. The *Phytologia* insists, that plants have vital organization, sensation, and even volition; and a number of instances are adduced to support the theory. This work obtained but little attention from the public, and was suffered to pass almost unnoticed.

The last production of Dr Darwin, is the *Temple of Nature, or the Origin of Society*, 4to, with notes. This work, "the setting emanation of this brilliant day-star," the Doctor had prepared for the press, a few months before his death, and was published in 1803. It treats of the production of life; the re-production of life; the progress of the mind; and of good and evil. It seems designed to illustrate the theory laid down in the first volume of the *Zoonomia*. Its aim is simply to amuse, by bringing distinctly to the imagination, the beautiful and sublime operations of nature, in the order in which the author believed the progressive course of time presented them. This work, like all his productions, contains some beautiful and inimitable passages. It is not, perhaps, equal to his *Botanic Garden*. It exhibits all his excellencies, and all his faults: it shews that the vigour of his body had not outlived the vigour of his mind—that the lamp of genius burnt brightly to the last. These, together with some papers in the *Philosophical Transactions*, and the share he had (which was considerable) in the formation of the *System of Vegetables of Linnæus*, published in the name of the Botanical Society of Lichfield, are all the published works of Dr Darwin.

During his residence in Derby, he founded a Philosophical Society there, and was its able and attentive president till the time of his death. In the library belonging to that society, a biographical tribute to his memory was lately read by one of his friends: from that paper, the writer of this article, who is also a member, has extracted some interesting matter, for which he returns his acknowledgments to the author.

In perspicuity, which is one of the first excellencies of poetic, as well as prose composition, Dr Darwin has, perhaps, few equals. He is clear, even when describing the most intricate operations of nature, or the most complex works of art; and there is a lucid transparency in his style, through which we see objects in their exact figure and proportion. He delights the eye, the taste, and the fancy, by the strength, distinctness, elegance, and perfect originality of his pictures; and gratifies the ear by the rich cadence of his numbers. But the passions are generally asleep, and seldom are the nerves thrilled by his imagery, impressive and beautiful as it is. The greatest defect in Dr Darwin's poetry is want of sensation;—that sort of excellency, which, while it enables us to see distinctly the objects described, makes us feel them acting on our nerves; and, perhaps, the dazzling, and excessive polish of his lines, may have a tendency to cloy, from their richness. His picturesque descriptions are elegantly drawn. In general his poetry is addressed to the reason, for it relates to science; and to the imagination, for it is employed in fiction—but it seldom touches the heart. The outlines of his figures are drawn with astonishing strength and accuracy; but they have a hardness and a coldness. By foregoing the use of that which is addressed to the feelings rather than the eye, he has not availed himself of those fine and fleeting circumstances and associations which are beyond the reach of the pencil, but which, in poetical painting, may be made to contribute powerfully towards the general impression. In the notes to his different works, we discover the botanist, the philosopher, the chemist, and the man of an exalted and daring genius. But though he often appears to advantage, it must be confessed that, in many instances, he sacrifices too much to imagination. Had Dr Darwin written less, his fame would have been greater.

In considering the character of Dr Darwin as a physician, the first observation that occurs, is the novelty of his practice. The cause of his not following the common mode of treating various diseases, was not the effect of mere singularity, nor the idle vanity of differing from others; but the result of much thought, labour, an ingenious and acute observation, of extensive views, and an unusually accurate acquaintance with the human frame. Success almost invariably resulted from the exertions of his genius. His strength of mind and courage increased with his deviations from the usual practice; and there were many instances of his giving back his dying patient to existence and to health, by his novel mode of treatment. The whole of Dr Darwin's life was spent in meditation and study. His thoughts were uniformly, intensely, and actively, devoted to the attainment of elegant literature; to scientific researches, to the investigation of disease, and to the luminous developement of the laws of nature. (D. P. D.)

DASYPOGON, a genus of plants of the class Hexandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl. &c.* p. 263; and BOTANY, p. 195.

DATAMES. See PERSIA.

DATISCA, a genus of plants of the class Diœcia, and order Dodecandria. See BOTANY, p. 338.

DATURA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 139.

DAUBENTON, LOUIS JEAN MARIE, a celebrated French naturalist, was born at Montbar in Burgundy, on the 29th of May, 1716, and was the son of a notary in that village. He received his education in a college of the Jesuits, and from his earliest years he exhibited that sweetness o disposition, and that love of study, which formed the principal traits in his character. After having spent some time at Paris in the study of divinity, Daubenton seems to have abandoned all thoughts of the church, and to have devoted himself entirely to the medical profession. He attended with great zeal the lectures of Winslow, Hunauld, Antony Jussieu, and Baron, and took his degree of doctor of medicine at

* A very able examination of the principal doctrines in the Zoonomia, will be found in a work, entitled, *Observations on Dr Darwin's Zoonomia*, by Dr Thomas Brown, now Professor of Moral Philosophy in the University of Edinburgh. ED.

Rheims in 1741, the year in which the death of his father left him at full liberty to abandon his theological pursuits. Upon his return to his native place to follow the practice of medicine, he began his career during the prevalence of an epidemic distemper which threatened to depopulate the country, and during the progress of which he displayed great ability; but he was soon called by an unforeseen accident into a situation more congenial to his wishes.

As soon as Buffon succeeded Dufay as intendant of the Royal Garden at Paris, he formed the plan of giving a complete view of the natural history of quadrupeds. His personal knowledge of Daubenton, who resided in the same village with himself, and who had devoted a great portion of his time to the study of comparative anatomy, induced him to request his assistance in that department of his work, for which he himself was by no means qualified. Daubenton, who had already, through the influence of Buffon, been appointed keeper and demonstrator of the cabinet of natural history in the Royal Garden, felt himself honoured by the proposal, and immediately commenced those labours which have immortalized his own name, and that of his illustrious associate. He furnished all the anatomical part, and all the technical description of one hundred and eighty-two species of quadrupeds, which Buffon has given in his splendid work. In a subsequent edition, Buffon separated the labours of his coadjutor from his own; and though Daubenton was chagrined at this apparent disrespect, which has been severely reprobated by Pallas and Cuvier, yet we must admit that the unity and popular character of his work was, by this means, more completely preserved. Daubenton was elected adjunct botanist in the Academy of Sciences on the 28th March, 1744, and associate on the 1st June, 1755. From the situation of associate botanist he passed to that of associate anatomist, and he was elected a pensionary on the 21st May, 1760.

The first paper which he presented to the Academy was entitled, *Distribution methodique des coquillages, et description particuliere d'une espece de buccin, ou de limaçon terrestre,* and appeared in the Memoirs for 1743. His next papers, entitled, *De la connaissance des pierres precieuses; Memoire sur l'hippomanes;* and *Observations sur la liqueur de l'allantoide,* appeared successively in the years 1750, 1751, and 1752. In 1756, he published his *Observations sur les Musaraignes, et en particulier sur un nouvelle espece de Musaraigne qui se trouvent en France, et qui n'a pas eté remarquée par Naturalistes.* This was followed by his *Memoire sur les Chauve-souris,* in 1759, in which he describes five new species of bats. The Memoirs of the Academy for 1772, contain the history of the civet cat, which produces the musc, and exhibits some curious details respecting the organization of that quadruped; and in 1781 he published another Memoir, respecting the organs of voice in several foreign animals.

In the application of comparative anatomy to zoology, Daubenton was equally industrious; and though all his conjectures have not been well founded, yet in his Memoir which appeared in 1762, entitled, *Sur des os, et des dents remarquables par leur grandeur,* he has corrected several erroneous views which had been entertained by preceding naturalists.

Persuaded that the term *animal* was used by Buffon in a sense too extended, and that it should be restricted to those that had red blood, he proposed, in a Memoir read to the National Institute in 1797, to divide them into vertebral and invertebral animals.

The attention of Daubenton was also directed to the subject of vegetable physiology. He was the first botanist who observed that the growth of the palm tree was effected by a prolongation of the central fibres, which developed themselves in leaves; and he was also the first who recognised in the coats of the trachea a kind of brilliant and aërial vessels, which had hitherto been observed only in the structure of wood.

In the department of mineralogy, Daubenton laboured with equal zeal. His *Tableau du regne mineral;* his researches on the formation of alabaster, published in the Memoirs of the Academy for 1754; and his Memoir on the Herborization in Stones, published in the Memoirs of the Academy for 1782, give him a strong claim upon the gratitude of mineralogists. But he had also the great honour of being the master of the illustrious Hauy, whose mineralogical and crystallographical labours have extended the boundaries of science.

His researches on the occipital hole in man, which appeared in the Memoirs of the Academy for 1766, under the title of *Memoire sur les differences de la situation du grand trou occipital dans l'homme et dans les animaux;* and his essay on Indigestion, are only works which he published, as immediately connected with his profession.

Daubenton had long directed his attention to the subject of sheep, and particularly to the amelioration of the French wool. The results of his investigations were laid before the Academy in a series of Memoirs, the first of which appeared in 1768, under the title of *Memoire sur le mechanisme de la rumination et sur le temperament des betes a laine.* He afterwards considered the advantages of keeping the sheep constantly in the fold; the amelioration of beasts and wool in general; the method of curing the diseases to which they are liable; the differences between French and foreign sheep; and the purgatives which are most suitable for that animal.

In order to render useful the results of his labours, he embodied them in a work entitled, *Instruction pour les Bergers, et les proprietaires de troupeaux,* which appeared in 1782.

The other works of this industrious naturalist were, his *Dictionnaire des animaux vertebres,* published in the *Encyclopedie Methodique,* and his Lectures in the Normal School. The last of all his works was entitled *Observations sur une petrifaction du mont de Terre Noire departement de la Loire,* which was published in the first volume of the Memoirs of the National Institute for 1798. The manuscripts which he left behind him were his Lectures in the Veterinary School, in the College of France, and in the Museum.

During the terrors of the French revolution, he preserved himself, by his prudence, from the disasters which befel so many of his friends and associates.

In the year 1795, when he had reached his eightieth year, it was necessary to procure a certificate of civism, in order to preserve a situation which he had filled during 50 years. Some of his friends, afraid that this certificate would be refused, advised him to present himself as a shepherd in the Assembly of Sans Culottes, and in that character to demand his certificate. This plan was attended with complete success; and in the habiliments of a shepherd, Daubenton obtained the certificate which was necessary for holding the Directorship of the Museum of Natural History.

In the year 1799, Daubenton was elected a member of the Conservative Senate; but he did not live long to enjoy this honour. He died in December 1799, in the 84th year of his age. His Eloge was pronounced by the celebrated naturalist Lacepede, at the opening of the course of Natural History in the Museum for the year 1800, and a notice of his life and works was afterwards published by the learned and eloquent Cuvier.

Daubenton was a member of the Royal Academy of Berlin, and was elected a Fellow of the Royal Society of London, on the 9th of January 1755. (*o*)

DAUCUS, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 163.

DAVENTRY, or DAVENTRE, pronounced DANETRE, a market town of England, in the county of Northampton, is situated on the side and top of a hill, and encircled with hills to the south and east, on a tongue of land between the rivers Nen and Avon. Mr Pennant derives the name of the town from *Dwy-avon-tre*, the town of the two Avons; though the inhabitants, from the way in which the name is pronounced, make it of Danish origin; accordingly the badge of the town arms is the effigy of a Dane cutting down a tree. Although the town contains some good houses, yet in general the houses are meanly built, and the streets are badly paved. The church and steeple are built of soft Kingston stone, and are tolerable pieces of modern architecture. The remains of a priory, founded in 1090, are still to be seen. What now remains is supposed to have been the refectory. The doors and windows are in the pointed Gothic, and there is a large flight of steps leading to the apartments. The priory was suppressed by Cardinal Wolsey, and the conventual was made the parochial church, which was taken down some years ago, where the new one was erected.

A grammar-school was founded in this town in 1576. Five boys are educated by a legacy of Lord Avon, formerly Bishop of Durham, and other twelve are supported at school at the expence of the corporation.

At the distance of nearly half a mile to the south of Daventry stands *Borough Hill*, or *Dane's Hill*, as it is commonly called, celebrated for the large encampment which occupies the greater part of its summit. It is like that of Worle Berry in Somersetshire, and in shape resembles the human foot, being about a mile long, and about a quarter of a mile at its greatest breadth; and contains about 190 acres. It is variously defended with two, three, or four valla, and an equal number of fosses. This encampment was divided by a rampart near the northern extremity of the hill. The part which it thus cut off from the large fortification, contained about 12 acres, and is nearly of a circular form. At the north-east end of this is a moat, which was the prætorium. On the south-east side of the hill, at the distance of 300 yards from the preceding encampment, there is a smaller one, occupying about an acre of ground, and encircled by a single fosse and vallum. It has entrances on the east and west sides, and is of an oblong form. At the foot of Borough Hill, on the south, is a space of six acres, called Burnt Walls, where the remains of walls and arched vaults have been discovered; and in the adjacent wood are traces of a fortification, which has been called John of Gaunt's Castle. Pennant thinks that the encampment is the work of the Britons, while other antiquarians consider Borough Hill as the site of the Roman station.

Daventry has a large weekly market, and four annual fairs, held on June 6, August 3, October 2, and October 27, which are famous for the sale of horses. There is here a race course about two miles long; and in the town there is a considerable manufactory of whips.

The following is an abstract of the population return for 1811, for the parish of Daventry.

Number of inhabited houses,	534
Families that occupy them,	628
Do. employed in agriculture,	143
Families employed in trade and manufactures,	413
Males,	1297
Females,	1461
Total population in 1811,	2758

See Evans' and Britton's *Beauties of England and Wales*, vol. xi. p. 53. Morton's *Natural History of Northamptonshire*. Whalley's *History and Antiquities of Northamptonshire*. (π)

DAVID I. and II. See SCOTLAND.

DAVIESIA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 221.

DAVIS'S STRAITS. See GREENLAND.

DAUPHINY. See ALPS HIGHER, DROME, and ISER.

DAX, DACQS, or ACQS, the *Aquæ Tarbellicæ*, and the *Aquæ Augustæ* of the ancients, is an ancient town of France, and chief place of a district of the same name, in the department of Landes. It is situated on the left bank of the Adour, and is defended by a castle of no great strength, and by some fortifications which are in a bad state. Dax, however, is a military position of importance, as it covers a road by which an enemy could penetrate from Spain into France, without going by Bayonne.

In the middle of the town is a large and deep basin, always full of smoking and almost boiling water, and forming a small rivulet that runs into the Adour. There are six convents in the town. It has a weekly market, and six fairs in the year.

The mineral springs of Dax, for which it is chiefly celebrated, are situated on the west side of the town. Three of them serve for bathing, and one for drinking. The water contains a small quantity of muriate and sulphate of lime; its temperature is 56°; it is clear and tasteless, and is used for gout and rheumatism. The environs of the town are very agreeable. The adjacent country produces corn, wine, and wood; and the principal trade of the place, which is greatly facilitated by the Adour, consists in deals, rosin, tar, wheat, brandy, and wine.

Several manufactures of cloths were established in Dax in the year 1766, and the poor children were brought up to assist in the different works. They were superintended by an Englishman, who was accidentally a prisoner in the town. As soon as the proprietors had obtained all his methods, they unjustifiably dismissed him; but they found, when it was too late, that his aid was essentially necessary, and the establishment went completely to ruin. Population 4398. The position of Dax, as ascertained trigonometrically, is West Long. 1° 3′ 3″, and North Lat. 43° 42′ 19″. (*j*)

DAY. See CHRONOLOGY, p. 402.

DCHOUFOUTKALE. See DSCHOUFOUTKALE.

DEAD SEA. See ASPHALTITES.

DEAFNESS. See SURGERY.

DEAF AND DUMB, *Education of the*. See DUMB.

DEAL, supposed to have been the *Dola* of Julius Cæsar, is a market and seaport town of England, in the hundred of Bensborough, lathe of St Augustine, and county of Kent. It is situated on the sea-coast opposite the Downs, which being a general rendezvous for all kinds of shipping, has contributed greatly to the prosperity of Deal. The coast is here bold and open, and by an extensive bank of beach stones and pebbles thrown up by the waves, the sea has defended the coast from its own violence. The town is composed chiefly of three streets, which are parallel to the coast, and are joined by others smaller and narrower. In the upper part of the town, the streets are broad and spacious, but in the lower part of it, they are narrow and dirty. The houses are chiefly built of brick, and are very irregular, but those which have been recently erected are more elegant and commodious. Besides the parish church, which is at a distance from the town, there is a chapel of ease in the lower town, which was erected about the beginning of the last century. It is built of brick, and is 80 feet by 50 in the inside. The roof is of timber, curiously framed, and wholly supported on the side walls. The castle, which consists chiefly of a round tower, for the accommodation of a small garrison, stands to the south of the town, has a drawbridge, and is surrounded by a deep ditch; but Deal is principally defended by the batteries and martello towers which were recently built on the adjacent eminences. The other public buildings are a regular custom-house, a naval storehouse, an extensive naval hospital, a public library, and a reading-room. Extensive barracks have also been erected near the castle.

The inhabitants are principally occupied in maritime operations. There is here a regular establishment of 49 pilots, for the safe conveyance of shipping from and to the Downs, and up the rivers Medway and Thames. The charges are regulated by the tonnage; and it is a privilege of the pilots of the upper book, (or those who have been longest on the list,) to pilot all ships that draw more than 11 feet 4 inches of water. By their intrepidity, and that of the *Hovellers*, or sailors who assist them, much valuable property, and many valuable lives, have been preserved in cases of shipwreck. Two markets are held here weekly, and two fairs annually. East Long. 1° 23′ 59″, and North Lat. 51° 13′ 5″.

The following is an abstract of the population return in 1811, for the parish.

Inhabited houses,	1,340
Families that occupy them,	1,582
Do. employed in agriculture,	25
Do. in trade and manufacture,	156
Do. not included in these classes,	1,401
Males,	3,382
Females,	3,969
Total population in 1811,	7,351

See Hasted's *History of Kent*; and Brayley's *Beauties of England and Wales*, vol. viii. p. 1019—1024. (*j*)

DEATH. See PHYSIOLOGY.

DEBRETZIN, DEBREZEN, a large and populous town of Austria, in Upper Hungary. This town is of the most wretched description. The streets are not paved, and in those which are most frequented, balks are laid down in the middle for the accommodation of foot passengers. The town is surrounded with a hedge, and the gates, which are like our common field gates, are stuck with thorns and brambles. The houses, which are thatched, have generally only one story, and have their gable ends towards the street. The Calvinists, who form the majority of the inhabitants, have a college, which is numerously attended; but the buildings are old and ruinous. The *Togati*, who alone live in the college, amount to 400. Eight of them are lodged in one room. The younger scholars, who are nearly one thousand in number, live out of the college. The library is filled with the classics and scholastic divinity.

One of the principal manufactures here is soap, which gives employment to 70 master boilers, and is made from natron, a natural mineral alkali, called szekso. It is an efflorescence, which is found on a sandy soil at a lake near Kismaria, only a few miles from Debretzin. The soap is sent to every part of Hungary. There is likewise a manufactory of woollen stuff resembling a sheep's skin, called *guba*, and another of pipes. There is an imperial saltpetre manufactory near the town, and also a few vineyards. About 1000 cwt. of saltpetre is annually sent from Debretzin to the Imperial Magazine at Cashaw; but only 200 cwt. of it is produced here. The rest is received in the impure state, and is only purified. Horned cattle are reared in great abundance in the neighbourhood. The inhabitants are obliged to go more than a quarter of a mile for water. Population 30,000. See Townson's *Travels in Hungary*, p. 238—249. (*w*)

DEBT, NATIONAL, is the name for the amount, accumulated in a course of years, of government expence above revenue. In former ages, the extent of the sum in hand constituted, in a great measure, the limit of the public outlay. Our ancestors, though equally desirous with us of augmenting their expenditure, had little conception of the method of obtaining temporary loans, and none whatever of making permanent ones, by forming their collective amount into a transferable stock. It was to the thought and ingenuity of the Italians, that Europe has to attribute this, along with many other discoveries. That reflecting people found out, that the way to give a value to a sum of debt, where the security was fair, however slow the progress of payment, was to convert the whole into a disposable property. The power of transferring shares from one individual to another, was thus rendered a kind of counterpoise to the want of present solvency on the part of the government; and it was found to be enough that government performed punctually the duty of paying the interest.

It was at the æra of the Revolution that this innovation first took place in our financial system. The public confidence in the new government, the establishment of freedom on a solid basis, and the ardour to repress the endless encroachments of Louis XIV. all combined to give stability to a plan, which would have sunk in a moment to the ground under the arbitrary sway of a James or a Charles. These considerations gave support to the system during the doubtful, and sometimes unsuccessful, contest, which was terminated by the peace of Ryswick. Notwithstanding a considerable reduction in the interval between that treaty and the death of King William, the funded debt of the country amounted, in 1701, to 16,000,000; and many grave politicians considered twenty millions as a ruinous point in the progress of accumulation.

After the peace of Utrecht, the attempts to discharge the national debt were made very gradually and feebly. A sinking fund, on a plan by no means unlike that of Mr Pitt, was established; but its operation was so slow, and so frequently interrupted, that the total discharge in the 27 years of peace, preceding the war of 1740, did not exceed L. 7,000,000 sterling. Queen Anne's war had carried the national debt to L. 50,000,000, and ministers finding that the country had been brought to bear the pressure of this load, were in no haste to attempt its alleviation: an attempt alone would it have been; for it is vain to talk of relieving the public from a burden contracted in the shape of debt, by war expences. The only mode of relief, as we shall shew more fully under the head of SINKING FUND, is by the imposition of fresh taxes; that is, by taking annually a sum out of our pockets to pay the interest, and eventually the capital of former arrears. This, in whatever way we view it, is little else than the transfer of a fund from one purpose to another; so that the sums expended in war may be clearly set down as so much absolute loss.*

At the peace of Aix-la-Chapelle, our debt was between seventy and eighty millions. The brilliant successes of the war of 1756, encouraging government to apply to Parliament for extravagant sums, the result was the accumulation of our debt, before the peace of 1763, to more than one hundred and twenty millions. The American war carried it above two hundred millions; and the war of 1793 made it more than double that amount. In these enumerations we are desirous to represent the sums, not in stock, but in sterling money; a calculation frequently attended with complexity, on account of the difficulty of reducing the various descriptions of stock to a sterling sum, by which we mean a sum bearing the regular legal interest of five per cent. In the present war, expensive as it has been beyond all precedent, and, we may add, beyond all conception, the addition to our debt has been comparatively inconsiderable. The extraordinary amount of our war taxes, and of the produce of the sinking fund, have formed powerful grounds of counteraction, to the infinite satisfaction of those well-intentioned persons who persuade themselves that the extraction of money from the capital of individuals, in the shape of taxes, is a less pernicious thing than the accumulation of public debt.

The following Table represents the gradual progress of our national debt till a late period. The sums are given, not in sterling money but in stock, and the debt of Ireland is not included.

Amount of the National Funded Debt at the Revolution, and at the commencement and termination of each subsequent War.

		Years.	Stock.
National debt at the Revolution,		1689,	L. 1,054,925
Funded debt at the peace of Ryswick,		1697,	21,515,772
.... at the commencement of the war of		1701,	16,394,701
.... at the peace of Utrecht,		1714,	55,282,978
.... at the commencement of the war,		1740,	47,954,623
.... at the peace of Aix la Chapelle,		1748,	79,193,313
.... at the commencement of the war,		1756,	73,289,673
.... at the peace of Paris,		1763,	133,959,270
.... at the commencement of the American war,		1775,	123,644,500
.... at the peace of Versailles,		1783,	238,231,248
And this was reduced by purchases for the redemption of the national debt, at the commencement of the war, to		1793,	227,989,148
Funded debt at the peace of Amiens 1802, including the loan of that year,	L. 567,008,978		
Of which redeemed, and in the hands of the commissioners for the reduction of national debt,	67,255,915		
		Leaves	499,753,063
There was no reduction of the national debt in the short peace which followed the treaty of Amiens.			
Funded debt 1st February 1812,	L. 769,764,356		
Of which redeemed,	189,538,480		
		Leaves	580,225,876

It may be useful to compare the progressive increase in the annual ratio of our contracted debt, in the successive wars since the Revolution. During the war of 1689, the annual average of debt contracted was two millions and a half, and in Queen Anne's war three millions. In the war of 1740 it was somewhat below four millions; and under the flattering successes of the contest of 1756, government found means to carry its annual augmentations to more than eight millions and a half. In our unfortunate contest with our colonies, the yearly average of addition to our debt was fourteen millions; and in the war of 1793, when our hopes were raised by a concurrence of circumstances, it exceeded thirty millions; a sum of surprising magnitude, when we add to it the farther burden imposed on the people for the payment of the taxes appropriated to the sinking fund. It is fit, however, to add, that these sums are calculated in stock. Of the sterling amount, a more accurate idea will be formed from the following Table.

Progress of the Funded Debt of Britain from 1793 to 1812.

Years.		Sterling Money.
1793	Loan	£4,500,000
1794	Loan	11,000,000
	Navy Bills	1,907,451
1795	Loan	18,000,000
	Navy Bills	1,499,647
	Loan	18,000,000
1796	Loan	7,000,000
	Navy Bills	4,226,727
	Loyalty Loan	18,000,000
1797	Loan	13,000,000
	Navy and Exchequer Bills,	13,029,399
1798	Loan	15,000,000
	Loan	3,000,000
1799	Loan	12,500,000
1800	Loan	18,500,000
	Carry over	£159,163,224

* The important subject of the Sinking Fund has been discussed in a most profound and perspicuous manner, by Dr R. Hamilton, in his "Inquiry concerning the Rise and Progress, the Redemption and Present State, and the Management of the National Debt of Great Britain." Edin. 1813. ED.

	Brought forward . . .	£159,163,224
1801	Loan	25,500,000
1802	Exchequer Bills	8,910,450
	Loan	23,000,000
1803	Loan	10,000,000
1804	Loan	10,000,000
1805	Loan	20,000,000
1806	Loan	18,000,000
1807	Loan	12,200,000
1808	Loan	8,000,000
	Exchequer Bills	4,000,000
1809	Loan	11,000,000
	Exchequer Bills	7,932,100
1810	Exchequer Bills	8,311,000
	Loan	8,000,000
1811	Exchequer Bills	7,018,700
	Loan	4,981,300
	Loan	12,000,000
		£356,854,673

Ireland dates the origin of her public debt at an epoch greatly posterior to that of Britain. It did not, indeed, exceed a few millions until the war of 1793, in the course of which it advanced with a rapidity almost as great, making allowance for the striking disproportion of funds, as the arrears of Britain. The sums borrowed were partly on the security of Ireland alone, but more on the joint security of Ireland and Britain. Of the latter, the following Table exhibits a list.

Loans for Ireland guaranteed by Britain.

1797	. . . .	L. 1,500,000
1798	. . . .	2,000,000
1799	. . . .	3,000,000
1800	. . . .	2,000,000
1801	. . . .	2,500,000
1802	. . . .	2,000,000
1803	. . . .	2,000,000
1804	. . . .	4,500,000
1805	. . . .	2,500,000
	Separate loan	1,500,000
1806	. . . .	2,000,000
1807	. . . .	2,000,000
	Separate loan	1,500,000
1808	. . . .	2,500,000
1809	. . . .	3,000,000
1810	. . . .	4,000,000
	Separate loan	1,400,000
		L.39,900,000

Reducing the various descriptions of British debt, funded and unfunded, to one general sum, and estimating the amount of that sum by the interest which government is pledged to pay, we shall find that in the present year our annual interest has risen, one way or another, to nearly thirty millions sterling. Multiplying this sum by twenty, on the assumption of five per cent. being the regular interest of money, we make a gross sum of six hundred millions sterling. This sum, large as it appears, will probably be found below the mark, because in the event of peace, 3 and 4 per cent. stocks may take a value not very remote from that of L. 100 in money. Applying a similar rule to the case of Ireland, we shall carry the amount of her debt to nearly eighty millions sterling, being somewhat less than a seventh of our own.

In examining the operation of our sinking funds prior to 1793, we cannot fail to be struck with the insignificance of its proportion to the general mass of our debt. In the long peace between 1714 and 1740, the average annual re-payment was only a two hundredth part of the whole. Again, in the pacific interval from 1763 to 1775, the ratio, though somewhat better, was still below the one hundred and thirtieth part of the capital; and between 1783 and 1793, it became less than ever, for it did not exceed a two hundred and twentieth part. The trifling proportion of these sums to the whole, seems to amount to a demonstration, that so long as wars are of frequent recurrence, the hope of paying off any considerable part of the national debt is a delusion. Each contest sinks us deeper and deeper into difficulty, and tends to create a suspicion that ministers have not been serious in their promises of extensive liquidation. In treating of the article SINKING-FUND, we shall take occasion to shew that this boasted engine is fitter to extract additional sums from the pockets of the people, than to operate a reduction of prior incumbrances. Farther explanations, in connection with this subject, will be given under the several heads of LOAN, LONG ANNUITY, LOTTERY, and TONTINE. The practical result of these different statements will be, that the calculations of extraordinary benefit, from the operation of compound interest, are unfounded, and that the only effectual source of reduction consists in the excess of revenue above expenditure.

We conclude by a Table explanatory of the progressive advance of our revenue from a very remote period. The inaccuracy and ambiguity of ancient records, prevent it from possessing a claim to the character of official accuracy; but it is notwithstanding curious as an approximation to a fair statement of the amount of the public income at various periods.

Computed amount of the Public Revenue at the commencement of each Reign.

	Years.	Sterling Money.
William the Conqueror, .	1066	L.400,000
William Rufus, ...	1087	350,000
Henry I.	1100	300,000
Stephen, ...	1135	250,000
Henry II.	1154	200,000
Richard I.	1189	150,000
John, ...	1199	100,000
Henry III.	1214	80,000
Edward I.	1272	150,000
Edward II.	1307	100,000
Edward III.	1347	154,139
Richard II.	1377	130,000
Henry IV.	1399	100,000
Henry V.	1413	76,643
Henry VI.	1422	64,976
Edward IV.	1460	100,000
Edward V.	1483	
Richard III.	1483	
Henry VII.	1485	400,000
Henry VIII.	1509	800,000
Edward VI.	1547	400,000
Mary, ...	1553	450,000
Elizabeth, ...	1558	500,000
James I.	1602	600,000
Charles I.	1625	895,819
The Commonwealth,	1648	1,517,247
Charles II.		1,800,000
James II.	1684	2,001,855
William III.	1688	3,895,205
Anne, ...	1706	5,691,805
George I.	1714	6,762,643
George II.	1727	8,522,540
George III.	1760	8,800,000

Increase of the Permanent Revenue in the present Reign.

Year.	Permanent Revenue.	Interest of Debt.	Free Revenue.
1760	8,800,000	4,700,000	4,100,000
1773	10,100,000	4,000,000	5,600,000
1780	12,250,000	7,500,000	4,750,000
1786	15,100,000	9,500,000	5,600,000
1791	16,700,000	9,250,000	7,450,000
1806	35,314,150	23,460,000	11,854,150

1806	Permanent Revenue,	L.35,314,150
	Temporary taxes, not payable in peace,	
	War taxes,	8,992,377
	Property tax,	4,377,583
		48,684,110
	Interest of debt,	23,460,000
		25,224,110
1807	Permanent taxes, and hereditary revenue,	38,414,099
	War tax, property tax, and incidents,	21,775,315
		60,189,414
	Interest of unredeemed debt, and charges of management,	20,701,252
	Free revenue,	39,488,162
1808	Annual produce of the sinking fund,	10,000,000
	Free revenue,	L.35,224,110

(χ)

DECAMERIDE, in Music, is an interval so named by M. Sauveur, who considered the octave as divided into 43 merides, each of these into 7 heptamerides, and each of these again into 10 decamerides, or the $\frac{1}{3010}$th part of the octave, which was done, to make the same conform nearly to the four first places of the reciprocal logarithms of VIII, and so that one in the fourth place of such reciprocal common logarithms may very nearly represent a decameride, which, as $\frac{1}{3010}\times$ VIII, has a common logarithm of .9998999,9003 = .2040574 Σ, whereas 9999000,0000 is the common log. and .2040370 Σ the value in Farey's notation of 1 in the fourth place of reciprocal logarithms. The decameride is =.0185374 in major comma logs. and =.000332226 in Euler's, or binary logs. or decimals of the VIII. (ϱ)

DECASPORA, a genus of plants of the class Pentandria, and order Monogynia. See Brown's *Prodromus*, &c. p. 548, and BOTANY, p. 174.

DECCAN, a general term signifying the *south*, and applied by the Hindoos to that immense tract of country lying to the south of the river Nerbudda. By some modern geographers it has been arbitrarily restricted, merely for their own convenience, to that part of India which lies to the south of the river Kistna, and its subsidiary streams. See CANARA, CARNATIC, INDIA, &c. (*j*)

DECIMALS. See ARITHMETIC, Vol. II. p. 395—403.

DECLINATION. See ASTRONOMY, Vol. III. p. 608.

DECOSTEA, a genus of plants of the class Diœcia, and order Pentandria. See BOTANY, p. 340.

DECUMARIA, a genus of plants of the class Dodecandria, and order Monogynia. See BOTANY, p. 224.

DECUPLE SCHISMA, in Music, is an interval equal to 10 schismas, or $9.992138\Sigma+m$; its common logarithm being .9950989.2767, its Euler's log. .0162810, and its comma log. .9084418. The *decuple minor comma* is $99.708541\Sigma+2f+9m$; the *decuple major comma* is $109.700678\Sigma+2f+10m$; the *decuple diaschisma* is $119.7006782+2f+10m$, &c. (ϱ)

DEDICATION. See CONSECRATION.

DEERINGIA, a genus of plants of the class Pentandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl.* p. 413, and BOTANY, p. 172.

DEFECTIVE INTERVALS, in Music, are such as are less than their true quantity; but with different authors this flattening differs. Some use the term for intervals less by the schisma, (or Σ,) others by the minor comma, (or $10\Sigma+m$,) the diaschisma, (or $12\Sigma+m$,) the enharmonic diesis, (or $21\Sigma+2m$,) and others again by the semitone minimum, (or $32\Sigma+3m$.)

DEFECTIVE SCALES, in Music, are such as are incapable, for want of a sufficient number of notes in an octave, of avoiding the use of *wolves*, occasioned by the substitution of one note for a different one which ought to be used. See *Philosophical Magazine*, vol. xxxvi. p. 39. All douzeaves are therefore defective, except perhaps the isotonic system, which some maintain to be made up entirely of wolves. Dr Robert Smith proposed, as a mode of tuning the common defective scale of 12 notes, that each fifth should be made to *beat* equally quick with the major third, to the same base, the former *flat*, and the latter *sharp*, except the resulting fifth between G ✻ and E♭. In his "Harmonics," 2d edit. p. 215, the *beats* of this system are calculated; and in the *Philosophical Magazine*, vol. xxxvi. p. 50, Mr Farey has given its temperaments. (ϱ)

DEFICIENT INTERVALS, in Music, in the nomenclature which we have adopted in our work, are such as are flatter than the true intervals by a major *comma* c, $(=11\Sigma+m)$. Sometimes these are called *comma-deficient* intervals. Double deficient intervals are lessened $2c$ $(=22\Sigma+2m.)$ Mr Holder, and some other writers, will be found to have used this prefix in different senses. His deficient less third, for instance, is $\frac{6}{7}$=3rd $-24.9476962\Sigma+f+2m$, instead of $3-c$. (ϱ)

DEFOE, or FOE, DANIEL, an English author of considerable eminence, was the son of James Foe, a citizen of London, and was born in London, it is believed, about the year 1663. His family being dissenters, he was educated at a dissenting academy, kept by Charles Morton at Newington Green. He is said to have followed, for some time, the profession of a hosier; but possessing little of the talents and attention requisite for the management of business, he was soon compelled to relinquish it, and thereafter devoted himself almost exclusively to literature and politics.

In the year 1683, before he had attained the age of twenty-one, he published a pamphlet against the prevailing sentiment in favour of the Turks, as opposed to the Austrians; and before the age of twenty-three, he joined the standard of the Duke of Monmouth, in 1685. Having escaped the dangers of war, and the fangs of legal prosecution, he found leisure to pursue his literary career, and was prompted by his zeal to mingle in the controversies of the reign of James II. whose government he efficaciously opposed.

Defoe was admitted a livery-man of London on the 26th of January 1687-8. At the period of the revolution, when, in consequence of the popular discontents, King William was obliged to dismiss his Dutch guards, Defoe, who possessed just notions on the subject of civil liberty, wrote his well known poem, *The True-born Englishman*, with the view of casting ridicule upon those who opposed the government. This production was well received by the public, and met with an almost unparalleled sale; it was also the means of introducing him to the person of King William, for whose favours the author always expressed his gratitude. In the year 1695, he was appointed accountant to the commissioners for managing the duties on glass, which office, however, fell when the commission was abolished by the suppression of the tax in 1699.

The death of William deprived Defoe of a patron and protector. During the furious party contests which ensued on the accession of Queen Anne, he took an active part in the discussion of the various political and religious questions which were then agitated; and his zeal drew upon him the resentment of the individuals in power. In the month of January 1702-3, a proclamation was issued, offering a reward of fifty pounds for discovering his retreat. In this proclamation he is charged with writing " a scandalous and seditious pamphlet, entitled, *The shortest way with the Dissenters*," an ironical production, which he gave to the world towards the end of the year 1702; and in the Gazette he is described as " a middle-sized spare man, about forty years old, of a brown complexion, and dark-brown coloured hair, but wears a wig, a hooked nose, a sharp chin, grey eyes, and a large mole near his mouth." It was to no purpose that Defoe published " An Explanation:" he was found guilty of a libel, sentenced to the pillory, and adjudged to be fined and imprisoned. The author, however, appears to have been so little affected by the ignominious part of his punishment, that he consoled himself, when in prison, by writing a hymn to the pillory. In the solitude of a gaol, he occupied himself in correcting for the press a collection of his writings, aud projected " The Review," a periodical paper, which was first published on the 19th of February 1703-4.

While he lay in the prison of Newgate, as he tells us, without hopes of deliverance, a verbal message was brought him from Sir Robert Harley, the Speaker of the House of Commons, desiring to know what he could do for him: to which Defoe answered by writing the story of the blind man in the gospel, concluding—*Lord, that I may receive my sight.* Harley became secretary of state in the month of April 1704; and by his interposition, the author was at length relieved from Newgate, in the month of August of the same year. Immediately after his deliverance, he retired to St Edmund's Bury, and continued his satirical productions, for which he was liable to occasional persecution.

In the year 1706, Defoe was called upon to engage in business of more importance. Lord Godolphin resolved to take the benefit of his talents in promoting the union with Scotland, and, with this view, introduced him to the queen, who expressed herself towards him in very flattering terms. In three days thereafter he was sent to Scotland; and he arrived at Edinburgh in the month of October. Here he zealously employed his pen in confuting the arguments urged by the opponents of the great measure which was then in agitation; and he attended the committees of Parliament, for whose use he made several of the calculations on the subject of trade and taxation. On the 16th of January following, the act of Union was passed by the Parliament of Scotland; and Defoe returned to London in February 1706-7. After his first benefactor, Harley, was driven from power, in 1707, Lord Godolphin still patronised him, and he continued to contribute his services to the government.

In the year 1709, Defoe published his *History of the Union*; a work which was little noticed on its first appearance, but which was republished in 1712, and a third time in 1786. In the same year he also published *The History of Addresses;* and in 1711, he gave a second volume of Addresses, with serious and comical remarks. Upon the change of ministry, in 1710, he was again thrown back upon his first benefactor, and by his means preserved his interest with the government. He now lived at Newington, in comfortable circumstances, occasionally publishing such tracts as his prejudices or necessities dictated.

On the 1st of February, 1710–11, the corporation of the city of Edinburgh, remembering the services which Defoe had rendered to Scotland, empowered him to publish the *Edinburgh Courant,* in the room of Adam Booge; though it does not appear probable that he continued long to act in the capacity of editor of that paper. He was then engaged, at a distance, in business of a more important nature, supporting Lord Oxford's South Sea project, by his *Essay on the South Sea Trade,* and publishing other tracts relative to the political measures of the day. Although an advocate for peace, he wrote against the treaty of Utrecht, conceiving that its terms were prejudicial to the commercial interests of this country. In the month of May 1713, he discontinued the *Review,* after having published it regularly during nine years; and commenced the publication of a *General History of Trade,* in monthly numbers, of which only two appeared. In these factious times he was compelled to seek personal safety in retirement. The place of his retreat is believed to have been Halifax, or the borders of Lancashire. At this period he published several pamphlets in favour of the Hanover succession; for which, however, he was arrested, obliged to give eight hundred pounds bail, and prosecuted by information, during Trinity term 1713. In Easter term of the same year he was committed to Newgate; but was soon released, upon making a proper submission; and his first benefactor, who was still in power, procured him the Queen's pardon in the month of November. When the Earl of Oxford was finally expelled from administration, it is probable that our author lost his original appointment; and upon the accession of George I. notwithstanding his services in support of the Protestant succession, he was discountenanced even by those who had derived benefit from his exertions.

In consequence of the persecutions and disappointments which he had so frequently experienced, Defoe seems now to have become weary of party writing, and began to turn his attention towards other subjects. In the year 1715, he published *The Family Instructor,* a useful work, which, although little noticed on its first publication, at length met with a general reception. To this work he afterwards added a second volume; and in 1722, he published his *Religious Courtship.* In the month of April 1719, he gave to the world the *Life and surprising Adventures of Robinson Crusoe,* the most popular of all his performances, of which the reception was immediate and universal. It has often been said, that Defoe had surreptitiously appropriated the papers of Alexander Selkirk, a Scottish sailor, who had been left ashore on the island of Juan Fernandez, in the South Sea, and had lived upon that desolate place for about four years, until he was at length relieved by Captain Woodes Rogers, in his voyage round the world. From this charge, however, the author of *Robinson Crusoe* is, we think, successfully vindicated by Mr Chalmers; and the fact is, that Selkirk's story had been already told in Woodes Rogers's voyage, published in 1712.

From this period, Defoe continued to employ his pen upon a variety of publications, the most remarkable of which are, *The Life and Piracies of Captain Singleton,* 1720; *the History of Moll Flanders,* 1721; *the Memoirs of a Cavalier,* which appear to have been published without a date; and *the Political History of the Devil,* 1726. To these may be added several works on trade and commerce, which are now little read. After a life so constantly and assiduously employed in literary pursuits, Defoe died, at an advanced age, in the month of April, 1731. Few authors have left behind them so great a variety of publications; and although many of the works of Defoe have long ceased to be perused with interest, there are some of his productions which will probably continue to be re-published and read so long as the English language endures.

The reader will find a long list of the numerous works of Defoe, annexed to Mr Chalmers's Life of the Author, published at the end of Stockdale's edition of *Robinson Crusoe*, London, 1790. (z)

DEGREE. See Astronomy, Geography, and Surveying *Trigonometrical.*

DEGUELIA, a genus of plants of the class Diadelphia, and order Decandria. See Botany, p. 285.

DELAGOA Bay, is a bay on the east coast of Africa, and is called by the Portuguese the bay of Lorenzo Marques, after the name of its discoverer, and likewise the bay of the Holy Ghost. It extends about 20 leagues from north to south, and 7 from east to west; but on account of the numerous shoals, the channel is not more than five miles broad. At the north point of the bay, or Cape St Mary's, is formed an island of the same name, separated by a rocky strait from the continent.

The chief rivers that run into the bay, are the Manica, the Machavanna, and Delagoa, or English River. The Manica, which is the most northern of the three, was discovered in 1545 by the Portuguese. Being at that time navigable for large vessels, they erected a fort, which is now in ruins; but from the accumulation of sand at the mouth of the river, they were obliged to abandon their settlement.

The Machavanna, which is the most southern of the rivers, is navigable to the place where the trade is carried on, within 30 leagues from its mouth, by boats that draw six feet of water.

The Delagoa, or English River, which lies between the other two, is distant about 8 leagues from the Machavanna river, and is navigable for nearly 200 miles by large boats, and for more than 40 miles by vessels that draw 12 feet of water. It has a bar, with about 15 feet on it at low water; and about 2 miles up the river there is a sufficient depth of water, where vessels generally lie in safety from every wind. The Dutch fort and factory were destroyed in 1727 by a squadron of English pirates. The Austrian, or Ostend East India Company, erected warehouses, and a battery of 12 guns, on the south side of the river, in 1777; but in consequence of a remonstrance from the court of Portugal, the Austrian government disavowed the settlement, and the ships and effects of the settlers were seized and carried off by the Portuguese. It is now principally frequented by English South Sea whalers, from the quantity of whales which are found in the bay. The Portuguese carry on an inconsiderable trade with the natives, and send annually a ship from Mozambique, and sometimes return with slaves. The Persees on the Malabar coast, occasionally send small vessels to Delagoa bay with piece goods, cutlery, wearing apparel, iron, copper, brass wire, buttons, Arrangoe beads, pipes, sugar, spirits, and tobacco, and receive in return elephants' teeth, the teeth of the hippopotamus, a little ambergris, and small quantities of gold dust.

The chief who resides at the village where the ships anchor, has about fourteen chiefs on the south side of the river subject to him, and reigns over a territory extending about 200 miles inland, and about 100 along the coast. The houses, which are circular, are about 15 feet in diameter, and are very neat. They have only one entrance, and are encircled with pallisadoes about four feet high. The soil is of a rich black mould, and is sown with rice or maize in the months of December or January. The dry season generally continues from April till October. Vegetables and fruit, but particularly the sugar cane, are raised in abundance; but there are no horses, asses, or buffaloes. The wild animals which are found here, are the tiger, the rhinoceros, antelope, hare, rabbit, wild hog; and there are also Guinea hens, quails, partridges, wild geese, and ducks. The natives are of a bright black colour. They are harmless and good-natured, but are very cunning in their dealings with strangers. Those on the north side of the river are great beggars, and those who live up the river, are more traitorous and cruel than those who live near the bay.

As soon as a vessel arrives, an officer, who is called the king of the water, gives information of it to the chief, who instantly comes down to the landing-place. After presenting him with liquor and old clothes, he gives a bullock in return; and by the aid of the king of the water, provisions and refreshments may be procured every day in great plenty, and at a reasonable price. A bullock of 3 or 4 cwt. may be obtained for a piece of coarse Surat piece goods. Fowls may be had for two metal buttons or an iron hoop each, and empty bottles, and old clothes, will readily procure vegetables and fruits of all kinds. Excellent fish of various kinds are to be had at a small rate, and sometimes turtle is obtained. Water and firewood also abound. Mr White supposes, that the inhabitants in the neighbourhood of the bay may amount to from six to ten thousand. Cape St Mary's, which is the north-east point of the island of the same name, is situated in east longitude 33° 15′, and in north latitude 25° 58′. See White's *Journal of a Voyage from Madras* 1800, and Milburn's valuable work on *Oriental Commerce,* vol. i. p. 56, 57. (π)

DELAWARE, the smallest of the united states of America, is bounded on the east by the Atlantic Ocean and by the river and bay of the same name, on the south by the parallel of 38° 29′ 30″, on the west by Maryland, and on the north by the territorial circle described, with a radius of 12 miles round the town of Newcastle, by which it is divided from Pennsylvania. This state, which derives its name from Lord De la War, is about 92 miles in its greatest length, and from 13 to 30 miles in breadth, and is divided into three counties, Newcastle, Kent, and Sussex, the first of which pays 8 parts, the second 7, and the third 6 parts of the taxes.

The general aspect of this state is that of an extended plain, favourable for cultivation. Some of the upper parts of the county of Newcastle indeed, are broken and irregular. The heights of Christiana are lofty and commanding, and the hills of Brandywine are rough and stony; but in the lower country there is very little diversity of level. The highest ridge of the peninsula runs through the state of Delaware, inclined to the eastern side, and is marked out by a chain of swamps, from which a number of waters descend on the west to the Chesapeake, and on the east to the river Delaware. Along the Delaware river, and about 9

Delaware.

miles into the interior, the soil is commonly a rich clay, which produces large timber, and is well adapted to the purposes of agriculture; but between this tract and the swamps, the soil is light, sandy, and of an inferior quality. In the county of Newcastle, the soil is a strong clay. In Kent it is mixed with sand, and in Sussex the sand greatly predominates. The productions of the soil are wheat, Indian corn, barley, rye, oats, flax, buck wheat, and potatoes. The wheat is held in the highest estimation, from its uncommon softness and whiteness, and is always preferred in the foreign markets. In the county of Sussex there are excellent grazing lands; and it exports great quantities of timber, obtained from the Cypress Swamp or Indian River, which extends about 6 miles from east to west, and nearly 12 from north to south, including an area of 50,000 acres.

The state of Delaware supplies Philadelphia with its staple commodity. No less than 265,000 barrels of flour, 300,000 bushels of wheat, 170,000 bushels of Indian corn, besides oats, barley, flax seed, paper, flat iron, snuff, and salted provisions, &c. are annually exported from the waters of the Delaware state. The following was the amount of exports from 1791 to 1796 inclusive:

Years.	Dollars.	Cents.
1791	119,878	93
1792	133,972	27
1793	93,559	45
1794	207,985	33
1795	158,041	21
1796	201,142	
1801	440,504	

Wheat being the staple commodity of this state, large establishments have been erected for manufacturing it into flour. Of these, the mills in the Brandywine are most worthy of notice; but as they are within half a mile of WILMINGTON, they will be described with more propriety under that article. There are also well constructed mills on Red Clay and White Clay creeks, and on other streams in different parts of the state.

The state of Delaware contains very few minerals. In the county of Sussex, and among the branches of the Nanticoke River, are large quantities of bog iron ore, well adapted for casting. Before the revolution it was wrought to a great extent, but since that event the business has greatly declined.

The Presbyterians are the most numerous and powerful sect in the state of Delaware, and have no fewer than 24 churches; the Episcopalians have 14; the Anabaptists 7; and there is a great number of Quakers and Methodists in the state, but particularly in the counties of Kent and Sussex.

The principal river in the state is the Delaware, or *Chihohocki*, as it was called by the natives. The rivers Pocomoke, Wicomico, Nanticoke, Choptank, Chester, Sassafras, and Bohemia, rise in the western parts of the state, and discharge their waters into Chesapeake Bay. Some of them are navigable about 25 miles up the country, by vessels of about 55 tons. Delaware bay is about 60 miles long, from the Cape to the mouth of the river at Bombay Hook, and is in some parts so wide, that a ship in the middle of it is invisible from the land. The river rises in two branches in the state of New York; the northernmost, called Mohawks, or Cockquago branch, having its origin in Lake Ustayantho, in Lat. 42° 25′. The bay and river are navigable for 155 miles up to the great or lower falls at Trenton, and a 74 gun-ship may go up to Philadelphia, which is 120 miles from the sea. Sloops are able to go 35 miles above Philadelphia to Trenton Falls. Boats of 9 tons can go 135 miles above that city, and Indian canoes 185 miles above it.

Delft, Delhi.

The state of Delaware was colonized by the Swedes in 1628, and constituted a part of New Sweden, now New Jersey. It was taken by the Dutch in 1656, and was afterwards subdued in 1683 by the Duke of York, who sold to William Penn the town of Newcastle, and 12 miles of the surrounding country. To this tract he afterwards added the county which extends as far as Cape Henlopen, divided it into three counties as at present, and added it to Pennsylvania. In 1701, he sold it to six individuals, who having obtained for it the privilege of a separate assembly, it took the name of the three counties of the Delaware. These three counties separated themselves at the revolution from Pennsylvania, and assumed the name of the state of the Delaware.

The population in 1790 was 50,097, of whom 8887 were slaves. More recently, the population has been estimated at 64,273, of whom 6153 are slaves. See Morse's *American Gazetteer*, Rochefoucauld de Liancourt's *Travels in the United States of America*, vol. ii. p. 266; and the article WILMINGTON. (π)

DELFT, in Latin *Delphi*, a large and fine city of Holland, is situated on the river Schie, between Rotterdam and the Hague, in one of the finest districts of the country. The city is nearly two miles in circumference, and is defended from the sea by three dykes. The streets are long, straight, and spacious; the houses are very handsome and good, and the town is divided into several quarters by fine canals, planted on each side with trees. The principal public buildings are the town or guildhall, which is very magnificent; the arsenal and four powder magazines, which were formerly the best supplied in Holland. Besides the reformed Dutch church, there is a French church, a Lutheran church, and some others for the Roman Catholics. The two principal churches are adorned with the tombs of Admiral Tromp, Admiral Piel Heyn, and the celebrated naturalist Leewenhoek. The superb monument erected to William of Nassau, shewing his faithful dog lying at his feet, is particularly worthy of notice. The palace is still shewn, where this prince was assassinated in 1584. Delft has been long celebrated for its earthen ware, which is manufactured in imitation of the porcelain of China and Japan. It is made of baked earth, covered with an enamel. Fine and coarse cloths are also manufactured here; and M. Cauzius has lately established a manufactory of instruments of physics, astronomy, and surgery. Distance from the Hague four miles. Population 22,200. (π)

DELHI, one of the soubahs or provinces of Hindostan, is bounded on the east by Agrah, on the west by Lahore, south by Agimere, and north by the Kummow hills. Its length, from the town of Pulwul, near Agrah, to the river Sutluz, is 160 coses; its breadth is 140 coses, from the Kummow hills to the town of Rewari. Delhi, once of considerable extent and importance, is now a very miserable province. Ravaged for more than half a century by incessant wars, its boundaries have been greatly circumscribed; many of its towns have been destroyed; and its fine country, formerly swarming with inhabitants, and teeming with the richest vegetable productions, now presents only scenes of gloomy desolation. Wheat, rice, sugar, indigo, millet, pulse, and fruits of various kinds, are the almost spontaneous productions of its fertile soil. No part of Hindostan enjoys a climate of so mild a temperature; yet its wretched inhabitants, groaning under the most grievous oppression, and in constant dread of being pillaged, have, for many years, scarcely dared to rear for themselves the means of a scanty subsistence. We fervently hope, that, under the milder influence of the British jurisdiction, which now extends to Delhi, confidence and industry will revive; and that the people will reap all the advantages which nature has placed within their reach. This province is now divided into eight circars or districts, namely, Shahjehanabad, Serhind, Hissar, Feiroozeh, Schaurunpore, Sumbal, Bedaoon, Narnoul. These are again subdivided into 289 inferior districts, yielding, according to the imperial register, a revenue of seventy-four crore, sixty-three lacks of dams, equivalent to L.1,850,000 sterling. (*k*)

DELHI, the chief town of the above province, was once the capital of Mussulman sovereignty in Hindostan, and at a remoter period, the seat of Hindu dominion over northern India. It is said, by some historians, to have been founded by Rajah Delu, who reigned in Hindostan prior to the invasion of Alexander the Great. Others ascribe its erection to Rajah Pettouvar, who flourished at a much later period. Its name in Sanscrit is Indraput, or the abode of Indra, one of the Hindu deities; and it is thus distinguished in the royal diplomas of the chancery office. It is first mentioned as the capital of Hindostan about the year 1200. Rising in importance as Canouge declined, it continued the unrivalled capital of India till the year 1398, when it was reduced, almost without a battle, by the resistless Tamerlane. It was on the month of December in that year, that this stern conqueror entered the city, planted on its walls the great standard of the Tartarian empire, and seated in all the pride of conquest on the throne of India, received the prostrate homage of the nobility of both nations. The wanton insolence, and the cruel ravages of the conquerors, having at length roused the inhabitants to resistance, Delhi, with all its fine monuments of art, was devoted to pillage; and, on the 13th of January, this imperial city was reduced to a heap of ruins. Under succeeding sovereigns, however, it recovered part of its former splendour, and was still accounted the capital of Hindostan, till Akbar, transferring the seat of royalty to Agra, towards the close of the sixteenth century, completed the destruction of Delhi. Of the ruins of this once superb city, the extent is not less than a circumference of twenty miles; and the environs to the north and south are crowded with the remains of spacious gardens and country houses of the nobility.

About the year 1631, Shah Jehan, grandson of Akbar, with the view of eternizing his memory, founded a town near the ruins of old Delhi, which received the name of Shah Jehan Abad, or the colony of Shah Jehan. By this name the modern Delhi continues till this day to be distinguished in Hindostan. It is situated in a champaigne country, on the western bank of the Jumna, a river, says Bernier, resembling the Loire. It is about seven miles in circumference; and, except on the side next the river, is surrounded by a wall of brick and stone. A parapet runs along the whole, but there are no cannon planted on the ramparts. The seven gates of the city, called the Lahore gate, Delhi gate, Agimere gate, Turkoman gate, Moor gate, Cabul gate, Cashmere gate, are built of stone, and have handsome arched entrances, where the guards of the city keep watch. The fortress, containing the Mahal or Seraglio, and other royal apartments, stands between the town and the river; from which it was separated by an area of considerable extent, where elephants used to be exercised, and where the militia of the Omrahs and Rajahs were frequently mustered before the king, who reviewed them from the windows of one of his apartments. The walls of the fortress were encompassed, except towards the river, by a ditch lined with freestone. Around this ditch was a spacious garden, beyond which was the great street, the *place royal*, where were erected the tents of the rajahs, who held there alternately their weekly guard. At the entrance to the palace, when Bernier wrote his description of it, were two stone figures, representing the rajah of Chittore and his brother Potta, seated on two elephants. These figures were afterwards removed by order of Aurengzebe, as tending to favour idolatry; and the place, on which they stood, he enclosed with a screen of red stone, which has very much disfigured the entrance. After entering the palace, the first object that attracts attention is the *Dewaun Aum*, or public hall of audience, a noble edifice, situated at the upper end of a spacious square. All round the square are apartments of two stories in height, the walls and front of which, while the empire retained its splendour, were richly adorned with tapestry, velvets, and silks, the rajahs and omrahs vying with each other in the magnificence of their decorations. A handsome gateway leads from the Dewaun Aum to the Dewaun Khass, situated likewise at the upper end of a spacious square, elevated upon a terrass of marble about four feet in height. This edifice, which is 150 feet in length by 40 in breadth, was, in better days, adorned with wonderful magnificence; and, though repeatedly despoiled by successive invaders, still retains sufficient splendour to excite admiration. The roof is flat, supported by numerous columns of fine white marble, which have been richly ornamented with inlaid flower-work of different coloured stones: The corners and borders have been decorated with frieze and sculptured work. The ceiling was formerly incrusted, through its whole extent, with a rich foliage of silver, which has long since been taken away. In the compartments of the walls the inlaying is exquisitely delicate. Around the exterior of the building, in the cornice, is an inscription in letters of gold, upon a ground of white marble, to the following effect: "If there be a paradise upon earth, this is it,—'tis this—'tis this." The terrace of this building is composed of large slabs of white marble, and on the top are four pavilions, or cupolas, of the same materials. A little to the northward of the Dewaun Khass are the royal baths, built by the Emperor Shah Jehan. They consist of three very large rooms, surmounted by domes of white marble. The walls within are lined with marble, about two-thirds of their height, having beautiful borders of flowers, worked cornelians, and other stones, executed with much taste. The floors are paved with marble in large slabs. From fountains in the centre, the water is conveyed by pipes to the different apartments; and large reservoirs of marble, four feet in depth, are placed in the walls. The light is admitted from the roof by windows of stained glass; and capacious stoves, with iron-gratings, are placed underneath each separate apartment. Adjoining to the baths is a very fine mosque. In the royal gardens is a very large octagon room, lined with marble, which faces the Jumna: It was through the window of this room that the late heir-apparent, Mirza Juwaun Bukht, made his escape in 1784, when he fled to Lucknow. Great part of the palace has been destroyed by the late invaders; the Rohillas, in particular, have stripped many of the rooms of their marble ornaments and pavements. The fort of Selim Ghur communicates with the palace by a bridge of stone built over an arm of the river: it is now entirely in ruins.

The royal gardens, begun in the fourth year of the reign of Shah Jehan, and finished in the thirteenth, were laid out with admirable taste, and are said to have cost the enormous sum of a million sterling. These gardens contained the *Dewaun Khana*, or hall of audience; an *Ivaun*, or open hall, with apartments adjoining, the interior of which is decorated with a beautiful border of white and gold painting, upon a ground of the finest *chunam;* on each side of the Ivaun are the apartments of the haram inclosed by high walls. These gardens, about a mile in circumference, still abound with trees of a large size, and very old.

Delhi contains the remains of many splendid palaces belonging formerly to the great Omrahs of the empire. The plans of all these palaces are nearly the same. All of them are surrounded by high walls, and take up a considerable space of ground. The entrances to all of them are through lofty arched gateways, at the top of which are the galleries for music; and before each is a spacious court-yard for the elephants, horses, and attendants of the visitors. Each has a Mahal, or seraglio, separated by a partition-wall from the great hall, with which it communicates by means of private passages. All of them had gardens, with capacious reservoirs of stone, and fountains in the centre. Round each palace extended an ample terrace; and within the walls were houses and apartments for servants and followers, besides stabling for horses, elephants, and every thing appertaining to a nobleman's suite. Each palace was likewise provided with a handsome set of baths, and a Teh Khana under ground.

The environs of Delhi to the north and west are crowded with remains of spacious gardens and country houses of the nobility, which were abundantly supplied with water by means of a canal dug by Ali Merdan Khan, and which formerly entered from above the city of Panniput down to Delhi, where it joined the Jumna, fertilizing a tract of more than nine miles. There was another aqueduct at Delhi, begun by order of Feeroze Shah, to supply with water a hunting seat at Sufedoom. This canal, which conveyed the water from Khizinabad, where it left the Jumna, was about sixty miles long, and was continued sixty miles more, by Shan Jehan, to his new capital of Delhi. These canals are now choked up with rubbish, to the great sorrow of the inhabitants, whose incessant prayer is that they may be cleared by the liberality of the British government.

This city is adorned with many beautiful mosques, the most remarkable of which is the *Jama Musjid*, or great cathedral. This elegant structure stands about a quarter of a mile from the Royal Palace, upon a rocky eminence, scarped on purpose. Four long and fine streets corresponding to the four sides of the mosque, terminate in the terrace on which it is built. This terrace is a square of about 1400 yards of red-stone; in the centre is a fountain lined with marble, for enabling the votaries to perform the necessary ablutions before prayer. The ascent is by a flight of stone steps, thirty-five in number, through a handsome gateway of red-stone. The large doors of this gateway are covered with plates of brass, exquisitely wrought. An arched colonnade of red-stone surrounds the terrace, which is adorned with octagon pavilions. The mosque is of an oblong form, two hundred and sixty-one feet in length; it is surrounded at the top by three magnificent domes of white marble, intersected with black stripes, and flanked by two minarets of black marble and red stone alternately, rising to the height of 130 feet. Each of these minarets has three projecting galleries of white marble, and their summits are crowned with light octagon pavilions of the same. The whole front of the building is faced with large slabs of beautiful white marble; and along the cornice are ten compartments, each four feet long, and two and a half wide, inlaid with inscriptions in black marble, and said to contain the greater part, if not the whole of the Koran. The floor of the mosque is paved with large slabs of white marble, decorated with a black border; its walls and roof are lined with plain white marble. Near the Kibla * is a handsome Taak, or niche, adorned with a profusion of frieze work; and close to this is a Mimber, or pulpit, of marble, which has an ascent of four steps balustraded. The ascent to the minarets is by a winding staircase of 130 steps of red stone; and at the top, the spectator is gratified by a noble view of the city, and of the opposite bank of the Jumna. The domes are crowned with cullises of copper richly gilt. This superb edifice, worthy of being the great cathedral of the empire of Hindostaun, was begun by the Emperor Shah Jehan, in the fourth year of his reign, and completed in the tenth: The expence of its erection is said to have amounted to ten lacks of rupees. The other mosques worthy of mention, are the Roshun Al Dowla, from which Nadir Shah beheld the massacre of the unfortunate inhabitants; and Zeenut Al Musajid, or the ornament of mosques, erected by Zeenut Al Nissa, a daughter of Aurengzebe. In a corner of the terrace on which this mosque is situated, that princess caused a sepulchre of white marble to be built, in which she was interred in the year of the Hegira 1122, (A. D. 1710). Besides these mosques, there are in Delhi and its environs above forty others, inferior in size and beauty, though all built in a similar style.

The other objects in Delhi which attract attention, are the Mudirussa, or college, erected by Gazoodeen Cawn, now uninhabited; and the tombs of Malika Zemani, queen of the Emperor Mahmud Shah, and of Jehanarah Begum, eldest daughter of the Emperor Shah Jehan—a princess no less famous for her wit, gallantry, and beauty, than for the noble proof which she gave of filial attachment, in undergoing a voluntary confinement of ten years with her father in the castle of Agrah.

From the account of these splendid structures, our readers are not to imagine, that Delhi presents an appearance of uniform magnificence. Here, as in all the Indian cities, the streets are narrow and irregular; and the houses, built without order, of brick, mud, or bamboos and mats, and generally covered with thatch, resemble a motley group of villages, rather than an extensive town. In Delhi, indeed, there were formerly two very noble streets, the one leading from the palace gate through the city to the Delhi gate, in a direction north and south; the other entering in the same manner, from the palace to the Lahore gate, lying east and west. The inhabitants have spoiled the beauty of both these streets, by running a line of houses down the centre, and in other places across the street, so that it is difficult to discover their former position.

* The Kibla is a small excavation in the wall of Mahommedan mosques, so situated as to look towards the city of Mecca.

In the better days of this city, Bernier supposed its population to be nearly equal to that of Paris. In the time of Shah Jehan, its yearly revenue amounted to L. 3,125,000. During the reign of Aurengzebe, (the third son of Shah Jehan,) who mounted the throne in 1659, the revenue of the city amounted to 1,221,950,137 dams, or L. 3,818,594; and its population was computed at two millions. It continued to increase in splendour and importance till the invasion of Nadir Shah, who demanded 30 millions sterling by way of ransom. It was on this occasion that 100,000 of the inhabitants were massacred, and 62 millions of plunder were said to have been collected. This unhappy city was again pillaged and depopulated in 1756, 1759, and 1760, by Ahmed Abdallah. Shah-Aulum, the lineal descendant of the house of Timoor, aspiring to the throne of his ancestors, put himself into the hands of the Mahrattas, who promised to support him in his enterprise. The distresses of this deluded prince compelled him at length to depute his son, in 1784, to solicit the assistance of the English. Since the peace of 1782, Madajæ Scindia, a Mahratta chief, and possessor of the principal part of Maliva, has taken the lead at Delhi, and has been endeavouring to extend his conquests on the side of Agimere, with the view of establishing a considerable kingdom. By these successive invasions and ravages, the opulence and population of Delhi have been greatly reduced, and are necessarily so fluctuating and precarious, that they cannot be exactly ascertained. North Lat. 28° 36′, East Long. 77° 40′. See Bernier's *Memoirs concerning the Empire of the Great Mogul,* vol. ii. Franklin's *History of the Reign of Shah-Aulum,* Appendix i. *Asiatic Researches,* vol. iv. (*k*)

DELOS. There are two islands situated in the mouth of the Greek Archipelago, called *Dili, Sidili,* or Great and Little Delos, which were particularly celebrated among the ancients, by the name of *Rhenæa,* and *Delos.* It is chiefly to the latter, as the more noted, that our attention shall here be directed.

Delos was celebrated neither for its size nor productions, being only seven or eight miles in circuit, and covered with a barren soil; but from its fame in the mysteries of Pagan mythology, it was considered of far greater importance than a rich and extensive sovereignty. According to fabulous story, when Latona, pregnant by Jupiter, was persecuted by Juno, Neptune raised the island from the bottom of the sea by a blow of his trident, in order to afford her a place of refuge; and it is said to have derived its name, signifying *to appear,* from the mode in which it was produced. Nevertheless, according to other traditions, the island long floated at the will of the waves, until Neptune fixed it to receive Latona, who was there delivered of twins, Apollo and Diana. Herodotus examined Delos in the course of his travels, and declares that it did not float; but some of the moderns have written dissertations to prove, that such might have been the case, without any violation of the law of nature.

This island was consecrated in a special manner to Apollo and Diana, who each derived a name from Mount Cynthus, a hill upon it; and some of the other heathen divinities had also temples there. It contained wealthy and populous cities, and its inhabitants, held in veneration as servants of the gods, were, by an Athenian decree, entitled to a golden crown in the festivals of Minerva. There was a magnificent temple dedicated to Apollo, which was erected by the united labours of all the Grecian potentates, who likewise jointly contributed to its preservation in suitable splendour. Plutarch informs us, that there was an altar in it deemed one of the wonders of the world, from the admirable art with which it was constructed; yet it consisted of nothing more than the horns of goats killed by Diana on Mount Cynthus, which were twisted into the proper form without glue or nails. Here there was a colossal marble statue of Apollo twenty-four feet high, presented by the inhabitants of the island of Naxos, now mutilated and in fragments; but the pedestal, a huge block of polished marble, and dedicatory inscriptions, yet remains. As Latona suckled her offspring under a palm tree, a brazen one, of great size, was erected beside the temple by Nicias, an Athenian general, which the ancients relate was overthrown on the statue by a tempest. The chief temple of Apollo was founded above 1500 years before Christ. Adrian, the Roman emperor, built two temples dedicated to Neptune and Hercules, and also a city called New Athens. The oracular responses to the credulous are reported to have been less mysterious in Delos than those delivered from the other fanes of Apollo.

All the surrounding nations, and some at a remote distance, concurred in celebrating the honours of the Delian divinities: hostilities were then laid aside, and mutual enemies might repair in safety to the island. Theseus, in commemoration of his escape from the Minotaur in Crete, instituted a divine legation, which was scrupulously preserved by the Athenians; and during its absence, or that of other deputations, no criminal could be put to death in their city. This legation, called the *Theory,* bore a crown of gold for Apollo, numerous victims for sacrifice, priests, and choirs of virgins to perform the sacred rites. An ancient inscription on marble, brought to Britain by the Earl of Sandwich in the earlier part of the preceding century, tends to elucidate this part of Pagan mythology. Its date remounts to about 374 years before the Christian æra, and it shows the expences lavished on superstitious offerings by the devotees of that period. The sums due to the temple of Delos, both by individuals and the Grecian states, are there enumerated, as well as the price of the golden crown for the god; of 109 oxen for sacrifice, paid to the captain of the galleys bearing the legation, and the remuneration of the archtheorist, who was at its head. On the arrival of the Theory, the statue of Apollo was crowned, and the victims offered; then dancing around the altars by young Athenians, representing the motions of the island while floating on the waves, commenced, in which the Delian females soon mixed, to figure the mazes of the Cretan labyrinth, whence Theseus returned in safety. Games, and competitions in poetry, likewise took place; and the Athenians instituted horse racing as a part of the former. The landing of the Theory having been irregularly conducted previous to the age of Nicias, when he was appointed arch-theorist, he carried the priests, choir, victims, and other preparations to the neighbouring island of Rhenæa, and cast a bridge five or six hundred yards long, richly ornamented with gold paintings and carpets, all made at Athens, over the intermediate channel to Delos. Thus, instead of the priests and choirs promiscuously hurrying from the vessels, and having taken their crowns and vestments, beginning to sing in a disorderly manner, a solemn and magnificent procession was conducted into the island. The same Grecian appropriated certain revenues, to give an annual feast to the Delians, in order to propitiate the gods; and the terms of his donation were engraven on a marble pyramid.

Great numbers of Greeks, with their wives and families, now resorted to the island, either from religious motives, or to enjoy the festivals; and virgins arrived from the Hyperboreans, bearing the first fruits of their country. The site of that nation is not ascertained, but we learn that the rights of hospitality having been violated with respect to their deputies, they thenceforward employed an intermediate people to convey their offerings. The decease of two priestesses is commemorated, who were entombed at Rhenæa, or Great Delos; for it was considered inconsistent with the sanctity of the island that the dust of mortals should be mixed with its soil, or that any one should be born upon it. Women whose term of parturition approached, were therefore carried to Rhenea, and likewise dying persons: It appears, however, that there was some difficulty in the latter case; for we find successive ordinances for the purification of the island, by transporting all the dead bodies from it to Rhenea: and on one occasion of purification, the Athenians, to whom the island belonged, expelled the whole inhabitants. "How can you call Delos your native country," said a certain person to another, "seeing you could neither be born there, nor can you die on it?"

The great resort of strangers enriched the island; it was equally famed for wealth and merchandize, and the ancients called it the treasury and emporium of Greece. Cornelius Nepos, speaking of a contribution by the states, uses these words: *Quantum pecuniæ quæque civitas daret Aristides delectus est qui constitueret. Ejus arbitrio quadraginta et sexaginta talenta quotannis Delum sunt collata. Id enim commune ærarium esse voluerint.* Cicero, in one of his orations, calls Delos "an island whither all repair with cargoes and merchandize." And Strabo describes it as a great and opulent emporium, of such importance, that a proverb passed current, "Merchants freight a ship, dispatch her thither, and every thing is sold."

Delos, along with the revolutions of the surrounding state, declined from its ancient splendour; it experienced disasters, and was plundered of its riches, whence Pausanias, who lived in the second century of the Christian æra, records its decay: "Delos, which was formerly the emporium of Greece, is now so completely deserted, that if the sacred deputations of the Athenians were discontinued, the island would be almost destitute of people, counting Delians only."

It is now covered with ruins, among which the columns, altars, porticoes, and inscriptions, attest its former glory; but whether the destruction of its magnificent edifices resulted from the hands of men, or from the convulsions of the earth, so common in those regions, has not been preserved in history. The names of many distinguished characters of antiquity are disclosed among the fragments, such as Philip king of Macedon, Nicomedes Epiphanes king of Bithynia, Mithridates, and the like. The theatre, which, from an ancient inscription, appears to have been situated within the city of Delos, consisted of white marble, and is shewn by its remains to have been about 250 feet in diameter and 500 in circuit. Not far from the sea, are also the remains of the Naumachia, for naval exhibitions, an oval basin 289 feet in length by 200 in breadth, and 4 feet deep above the rubbish covering the bottom. The whole has been plastered with a very thick cement to confine the water, and it was encircled by a row of columns. Besides these, there are the ruins of a gymnasium, where competitions took place for prizes, which, to this day, is called "the schools," by the neighbouring islanders. The stream Inopus, exaggerated by the ancients as a river, is at present an inconsiderable brook rising from a fountain.

Delos is now totally deserted, except when occasionally the resort of pirates, who are said to murder navigators, and throw their bodies into the sea. Its ruins are likewise a copious store of materials, either for forming bullets for the unwieldy artillery of the Turks, or for being employed in other edifices by the inhabitants of the Archipelago.

Great Delos is an island considerably larger than the other, being fifteen or eighteen miles in circuit. The soil is said to be peculiarly adapted for the culture of vines and olives, and the Greeks of Myconi sow the most fertile parts with grain, and pasture some flocks upon it. Thus it is more favourable for population than *Little Delos,* which consists universally of schist or granite, and Mount Cynthus is entirely a hill of the latter. Though the history of the lesser island is the more celebrated, Great Delos appears, from the ruins with which it is covered, to have scarcely been inferior in splendour; and the tombs which are spoken of by the ancients still remain, some being of surprizing elegance. A Greek historian observes, that in his time most of them were occupied by the bodies of Carians and Phenicians, which was ascertained by their armour and the position wherein they lay. Tournefort counted 120 altars, which were chiefly cylindrical, and ornamented by sculptures.

The Knights of Malta had an establishment on Great Delos, which afterwards fell to decay, and the island is no longer inhabited. The inhabitants of Myconi pay a small revenue to the Turkish government for the privilege of occupying both for temporary uses. See Spanheim *Observationes in Hymnum Callimachi in Delum,* p. 316—525; Taylor *Marmor Sandvicense;* Corsinii *Fasti Attici;* Spon *Miscellaneæ eruditæ Antiquitatis*; Spon et Wheler *Voyages,* tom. i. p. 172; Tournefort *Voyages,* tom. i. p. 342; Choiseul *Voyage Pittoresque de la Grece,* tom. 1. p. 50; and Olivier *Voyages,* tom. 3. p. 305. (c)

DELPHI. See GREECE and ORACLE.

DELPHINIUM, a genus of plants of the class Polyandria, and order Trigynia. See BOTANY, p. 237.

DELTA. See EGYPT.

DELUGE, in theology, signifies in general any great inundation; but more particularly that universal flood by which the whole inhabitants of this globe were destroyed, except Noah and his family. According to the most approved systems of chronology, this remarkable event happened in the year 1656 after the creation, or about 2348 before the Christian æra.

Of so general a calamity, from which only a single family of all who lived then on the face of the earth was preserved, we might naturally expect to find some memorials in the traditionary records of Pagan history, as well as in the sacred volume, where its peculiar cause, and the circumstances which attended it, are so distinctly and fully related. Its magnitude and singularity could scarcely fail to make an indelible impression on the minds of the survivors, which would be communicated from them to their children, and would not be easily effaced from the traditions even of their latest posterity. A deficiency in such traces of this awful event, though perhaps it might not serve entirely to invalidate our belief of its reality, would certainly tend considerably to weaken its claim to credibility; it being scarcely probable that the knowledge of it should be utterly lost to the rest of the world, and confined to the documents of the Jewish nation alone. What we might reasonably expect, has, accordingly, been actually and completely realised. The evidence which has been brought, from

Deluge.

almost every quarter of the world, to bear upon the reality of this event, is of the most conclusive and irresistible kind; and every investigation, whether etymological or historical, which has been made concerning heathen rites and traditions, has constantly added to its force, no less than to its extent.

And here, it were injustice to the memory of ingenuity and erudition, almost unexampled in modern times, were we not to mention the labours of Bryant, the learned annalist of *Ancient Mythology*, whose patience and profoundness of research have thrown such new and convincing light on this subject. Nor must we forget his ardent and successful disciple Mr Faber, who, in his *Dissertation on the Mysteries of the Cabiri*, has, in travelling over similar ground with his illustrious master, at once corrected some of his statements, and greatly strengthened his general conclusions. As the basis of their system, however, rests on a most extensive etymological examination of the names of the deities and other mythological personages worshipped and celebrated by the Heathen, compared with the varied traditions respecting their histories, and the nature of the rites and names of the places that were sacred to them, we cannot do more, in the present article, than shortly state the result of their investigations, referring for the particular details, to the highly original treatises already mentioned. According to them, the memory of the deluge was incorporated with almost every part of the Gentile mythology and worship: Noah, under a vast multitude of characters, being one of their first deities, to whom all the nations of the Heathen world looked up as their founder; and to some circumstance or other in whose history, and that of his sons and the first patriarchs, most, if not all, of their religious ceremonies may be considered as not indistinctly referring. Traces of these, neither vague nor obscure, they conceive to be found in the history and character, not only of Deucalion, but of Atlas, Cronus, or Saturn, Dionusos, Inachus, Janus, Minos, Zeus, and others among the Greeks; of Isis, Osiris, Sesostris, Oannes, Typhon, &c. among the Egyptians; of Dagon, Agruerus, Sydyk, &c. among the Phenicians; of Astarte, Derceto, &c. among the Assyrians; of Buddha, Menu, Vishnu, &c. among the Hindus; of Fohi, and a deity represented as "sitting upon the lotos in the midst of waters," among the Chinese; of Budo and Iakusi among the Japanese, &c. &c. They discover allusions to the ark, in many of the ancient mysteries, and traditions with respect to the dove and the rainbow, by which several of these allegorical personages were attended, which are not easily explicable, unless they be supposed to relate to the history of the deluge. By the celebrated Ogdoas of the Egyptians, consisting of eight persons sailing together in the sacred *baris* or ark, they imagine the family of Noah, which was precisely eight in number, to have been designated; and in the rites of Adonis or Thammuz, in particular, they point out many circumstances which seem to possess a distinct reference to the events recorded in the sixth and seventh chapters of Genesis. With regard to this system, we shall only further observe, that, after every reasonable deduction is made from it, which the exuberant indulgence of fancy occasionally exhibited by its authors appears to render necessary, it contains so much that is relevant and conclusive, that we cannot but express our conviction, that it has a solid foundation in truth and fact; it being scarcely possible to conceive, that a mere hypothesis could be supported by evidence so varied, so extensive, and in many particulars so demonstrative as that which its framers have produced.

Bryant's system.

Besides, however, the allusions to the deluge in the mythology and religious ceremonies of the Heathen, to which we have thus concisely adverted, there is a variety of traditions concerning it still more direct and circumstantial, the coincidence of which, with the narrative of Moses, it will require no common degree of sceptical hardihood to deny. These we shall now shortly adduce; beginning with those which are more distant and obscure, and then stating those which are more remarkably and circumstantially coincident with the Mosaic record.

Direct traditions.

We are informed by one of the circumnavigators of the world, who visited the remote island of Otaheite, that some of the inhabitants being asked concerning their origin, answered, that their supreme God having, a long time ago, been angry, dragged the earth through the sea, when their island was broken off and preserved.

In Otaheite,

In the island of Cuba, the people are said to believe, that "the world was once destroyed by water, by three persons," evidently alluding to the three sons of Noah. It is even related, that they have a tradition among them, that an old man knowing that the deluge was approaching, built a large ship, and went into it with a great number of animals; and that he sent out from the ship a crow, which did not immediately come back, staying to feed on the carcases of dead animals, but afterwards returned with a green branch in its mouth.

Cuba,

The author who gives the above account, likewise affirms, that it was reported by the inhabitants of Castella del Oro, in Terra Firma, that during a universal deluge, one man, with his children, were the only persons who escaped, by means of a canoe, and that from them the world was afterwards peopled.

Terra Firma,

According to the Peruvians, in consequence of a general inundation, occasioned by violent and continued rains, a universal destruction of the human species took place, a few persons only excepted, who escaped into caves on the tops of the mountains, into which they had previously conveyed a stock of provisions, and a number of live animals, lest when the waters abated, the whole race should have become extinct. Others of them affirm, that only six persons were saved, by means of a float or raft, and that from them all the inhabitants of the country are descended. They farther believe, that this event took place before there were any *incas* or kings among them, and when the country was extremely populous.

Peru,

The Brazilians not only preserve the tradition of a deluge, but believe that the whole race of mankind perished in it, except one man and his sister; or, according to others, two brothers with their wives, who were preserved by climbing the highest trees on their loftiest mountains; and who afterwards became the heads of two different nations. The memory of this event they are even said to celebrate in some of their religious anthems or songs.

Brazil,

Acosta, in his history of the Indies, says, that the Mexicans speak of a deluge in their country, by which all men were drowned; and that it was afterwards peopled by *Viracocha*, who came out of the lake Titicaca: and, according to Herrera, the Mechoachans, a people comparatively in the neighbourhood of Mexico, had a tradition, that a single family was formerly preserved in an ark amid a deluge of waters; and that along with them, a sufficient number of animals were saved to stock the new world. During the time that they were shut up in the ark, several ravens were sent out, one of which brought back the branch of a tree.

Mexico,

Deluge. Iroquois.

Among the Iroquois it is reported, that a certain spirit, called by them Otkon, was the creator of the world; and that another being called Messou, repaired it after a deluge, which happened in consequence of Otkon's dogs having one day when he was hunting with them lost themselves in a great lake, which, in consequence of this, overflowed in its banks, and in a short time covered the whole earth.

Oriental testimonies.

Passing from the more remote western to the eastern continent, nearer to the region where Noah is generally supposed to have lived, we find the traditions respecting the deluge still more particular and minute.

Josephus.

According to Josephus, there were a multitude of ancient authors, who concurred in asserting that the world had once been destroyed by a flood: "This deluge," says he, "and the ark, are mentioned by all who have written Barbaric histories, one of whom is Berosus the Chaldean. Speaking of this event, he affirms, that in Armenia, upon a mountain of the Corydeans, part of the ship is even yet remaining. It is a custom to scrape from off it some of the bitumen with which it was covered, and to carry it about as a talisman against diseases. Jerome the Egyptian, who wrote the ancient history of Phenicia, and Mnaseas, and many others, likewise mention these events. Nicolaus Damascenus relates, that there is a great mountain in Armenia, situated above Minyas, which is called *Baris,* to which many persons fled at the time of the deluge, and were preserved. One in particular was conveyed in an ark to the very summit of the mountain, and a considerable part of the vessel still remains. He perhaps may be the man concerning whom Moses the Jewish lawgiver wrote." Joseph. *Antiq. Jud.* lib. i. cap. 12.

Melo.

Eusebius (*Præp. Evang.* lib. ix. c. 19.) informs us, that Melo, a bitter enemy of the Jews, and whose testimony is on this account peculiarly valuable, takes notice of the person who was saved along with his sons from the flood, having been, after his preservation, driven away from Armenia, whence he retired to the mountainous parts of Syria. Abydenus, after giving an account of the deluge from which Xisuthrus, the Chaldean Noah, was saved, concludes with asserting, in exact concurrence with Berosus, that the ark first rested on the mountains of Armenia, and that its remains were used by the natives as a talisman. (Eusebii *Præp. Evang.* lib. i. c. 12.) And Plutarch (*de Solert. Animal.* v. ii.) mentions the Noachic dove, being sent out of the ark, and returning to it again, as an intimation to Deucalion that the storm had not yet ceased.

Chinese tradition.

This, however, is by no means all. Sir W. Jones, speaking of one of the Chinese fables, says, "Although I cannot insist with confidence, that the *rainbow* mentioned in it alludes to the Mosaic narrative of the flood, nor build any solid argument on the divine person Niu-va, of whose character, and even of whose sex, the historians of China speak very doubtfully; I may nevertheless assure you, after full inquiry and consideration, that the Chinese believe the earth to have been wholly covered with water, which, in works of undisputed authenticity, they describe as *flowing abundantly,* then *subsiding,* and *separating the higher from the lower age of mankind;* that the divisions of time, from which their poetical history begins, just preceded the appearance of Fo-hi, in the mountains of China; but that the great inundation in the reign of Yao, was either confined to the low lands of his kingdom, if the whole account of it be not a fable, or if it contains any allusion to the flood of Noah, has been ignorantly misplaced by the Chinese annalists." *Asiat. Research.* vol. ii. *Diss. on the Chinese.*

Egyptian.

The account given by Plutarch of the Egyptian Osiris, affords some grounds for imagining, that he also is the same person with Noah. He is said to have been a husbandman, a legislator, and a zealous advocate for the worship of the gods. Typhon having conspired against him, and, by a stratagem, having prevailed on him to enter into an ark, which was immediately closed on him, he, in this situation, floated down the Nile into the Sea. Now as, according to Plutarch, Typhon is merely a mythological person expressive of the ocean, this tradition evidently signifies nothing more than that the character denominated Osiris was in danger from the sea, and that he escaped by entering into an ark. Nor is it undeserving of notice, that he is said to have entered this vessel on the *seventeenth* of the month Athyr, which precisely agrees with the day of the patriarch's embarkation, previous to the commencement of the deluge. (*Plut. de Isid. et Osir.* p. 356, &c.) Plato also mentions, that a priest of Sais declared to Solon, that, previous to the partial deluges of Ogyges and Deucalion, a universal one had taken place, in which the original constitution of the earth was considerably altered. *Timæus,* p. 23. It is no doubt true, that Diodorus Siculus (*Bibl. Hist.* lib. i.) asserts, that the Egyptians maintained the flood of Deucalion to have been universal; but this discrepancy must appear, to every one who attends to the confusion which frequently pervades different accounts of the very same event, insufficient to invalidate the position, that the Egyptians *did* believe in a deluge that was universal.

Persian.

A similar belief prevailed among such of the ancient Persians as professed to hold their religion in its ancient purity, though some sects among them denied it entirely, and others maintained that it was only partial. Zoroaster is said to have affirmed, that such a catastrophe was occasioned by the wickedness and diabolic arts of a person called Malcûs; and, according to another of their authors, Noah himself dwelt in the mountain from which the waters of the deluge burst forth, though, by the same writer, an absurd tradition is mentioned of the particular place from which they issued: "*Zala-Cupha dicitur fuisse nomen vetulæ ex cujus furno aqua diluvii primo erupit.*" Hyde *de Relig. Vet. Pers.* c. x.

Chaldean.

Berosus, who lived in the time of Alexander, and wrote the history of the Babylonians, relates, that the general deluge happened in the days of king Xisuthrus, who, like Noah, was the *tenth* in descent from the first created man. Having in a dream been warned by Cronus or Saturn of the approaching calamity, he was commanded to build an immense ship, and embark in it with his wife, his children, and his friends; having first furnished it with provisions, and put into it a number both of birds and fourfooted animals. As soon as these preparations were completed, the flood commenced, and the whole world perished beneath its waters. After it began to abate, Xisuthrus sent out some of the birds, which, finding neither food nor resting-place, returned immediately to the ship. In the course of a few days he again let out the birds, but they came back to him having their feet covered with mud. The third time, however, that he sent them out, they returned no more. Concluding from this that the flood was decreasing, and the earth again appearing, he made an aperture in the side of the vessel, and perceived that it was approaching a mountain on which it, Deluge. soon after rested, when he disembarked with his family, adored the earth, built an altar, and sacrificed to the gods. Xisuthrus having suddenly disappeared, his family heard a voice in the air, which informed them, that the country in which they were was Armenia, and directed them to return to Babylon. *Syncelli Chronolog*. p. 30. Eusebii *Præp. Evang*. lib. ix. c. 12. and Joseph. *Antiq. Jud.*

Greek. Still more coincident even than this with the Mosaic account, is the Grecian history of the deluge, as preserved by Lucian, a native of Samosata on the Euphrates: and his authority is the more incontrovertible, on account of his being an avowed derider of all religions. The antediluvians, according to him, had gradually become so hardened and profligate, as to be guilty of every species of injustice. They paid no regard to the obligation of oaths; were insolent, inhospitable, and unmerciful. For this reason they were visited with an awful calamity. Suddenly the earth poured forth a vast quantity of water, the rain descended in torrents, the rivers overflowed their banks, and the sea rose to a prodigious height; so that "all things became water," and all men were destroyed, except Deucalion. He alone, for the sake of his prudence and piety, was reserved to a second generation. In obedience to a divine monition, he entered, with his sons and their wives, into a large ark, which he had built for their preservation; and immediately swine, and horses, and lions, and serpents, and all other animals which live on earth, came to him by pairs, and were admitted into the ark. There they became perfectly mild and innoxious, their natures being changed by the gods, who created such a friendship between them, that they all sailed peaceably together, so long as the waters prevailed over the surface of the globe. Lucian further adds, that, according to an ancient tradition at Hierapolis in Syria, there was once in that country a great chasm, through which the waters of the flood descended, and that Deucalion erected altars, and built a temple to Juno over its mouth. This aperture under the temple, he declares he had seen, thought it was then but of small size: and he relates a ceremony which took place twice every year, in memory of this catastrophe. Vessels full of water were brought from the sea, not only by the priests, but by the inhabitants of all Syria and Arabia; often attended also by multitudes from beyond the Euphrates. The water thus brought, was poured on the floor of the temple, and speedily sunk into the chasm; which, small as it was, received without difficulty the greatest quantity of water. And when they did this, the people said that "Deucalion himself had appointed it as a memorial of the deluge, and of his own deliverance from it." Lucian, *de Deâ Syriâ.*

Hindu. Scarcely less remarkable is the Hindoo tradition, with which we shall conclude this induction of testimonies to the reality of the deluge. It is contained in the ancient poem of the *Bhagavat*; and forms the subject of the first Purana, entitled Matsya, or the Fish. The following is Sir William Jones's abridgment of it, and the identity of the event which it describes, with that of the Hebrew historian, is too obvious to require any particular illustration. "The demon Hayagriva having purloined the Vedas from the custody of Brahma, while he was reposing at the close of the sixth Manwantara, *the whole race of men* became corrupt, *except the Seven Rishis,* and Satyavrata, who then reigned in Dravira, a maritime region to the south of Carnata. This prince was performing his ablutions in the river Critamala, when Vishnu appeared to him in the shape of a small fish, and after several augmentations of bulk in different waters, was placed by Satyavrata in the ocean, where he thus addressed his amazed votary: In seven days, all creatures who have offended me shall be destroyed by a deluge, but thou shalt be secured in a capacious vessel miraculously formed; take therefore all kinds of medicinal herbs, and esculent grain for food, and together with the seven holy men, your respective wives, and pairs of all animals, enter the ark without fear: then shalt thou know God face to face, and all thy questions shall be answered. Saying this, he disappeared; and after seven days, the ocean began to overflow the coasts, and the earth to be flooded by constant showers, when Satyavrata, meditating on the deity, saw a large vessel moving on the waters. He entered it, having in all respects conformed to the instructions of Vishnu; who in the form of a vast fish, suffered the vessel to be tied with a great sea serpent, as with a cable, to his measureless horn. When the deluge had ceased, Vishnu slew the demon, and recovered the Vedas, instructed Satyavrata in divine knowledge, and appointed him the seventh Menu, by the name of Vaivaswata." (*Asiat. Res.* vol. ii. on Chronol. of the Hindus.) And "according to the Pauranics, and the followers of Buddha," says Capt. Wilford, "the ark rested on the mountain of *Aryavarta, Aryawart,* or *India*; an appellation which has no small affinity with the *Ararat* of Scripture." *Ibid.* vol. vi. p. 521.

When we thus meet with some traditions of a deluge in almost every country, though the persons saved from it are said, in those various accounts, to have resided in different districts widely separated from each other, we are constrained to allow that such a general concurrence of belief could never have originated merely from accident. While the mind is in this situation, scripture comes forward, and presenting a narrative, more simple, better connected, and bearing an infinitely greater resemblance to authentic history, than any of those mythological accounts which occur in the traditions of Paganism, immediately flashes a conviction upon the understanding, that this must be the true history of those remarkable facts, which other nations have handed down to us, only through the medium of allegory and fable. By the evidence adduced in this article, indeed, the moral certainty of the Mosaic history of the flood appears to be established on a basis sufficiently firm to bid defiance to the cavils of scepticism. "Let the ingenuity of unbelief first account satisfactorily for this universal agreement of the Pagan world; and she may then, with a greater degree of plausibility, impeach the truth of the scriptural narrative of the deluge."

Besides the authorities already quoted, see Purchas's *Pilgrim*, b. ix. c. 5. 8. 10; Wilford *on Egypt; Asiat. Res.* vol. iii.; Maurice's *Indian Antiq.*; *Ancient Universal History*, vol. i.; Faber's *Horæ Mosaicæ*; and Cuvier's *Essay on the Theory of the Earth.* (*d*)

DELUGE, or Debacle, in Geology. Some writers have attempted to prove that traces of a deluge are apparent on the surface of the earth. Immense blocks of stone are found at a great distance from their native rocks; the bones of animals and the remains of plants, are found buried in regions far removed from what is supposed to be their native climate; and even in solid rock, both animal and vegetable substances abound, proclaiming mighty changes in the arrangement of the materials which compose the crust of the globe.

Disputes have arisen among philosophers respecting the reference of these appearances to a deluge, and the mode in which that agent might be brought into action by natural causes. We propose in a future article to enter pretty fully into the subject, when a greater number of facts shall have been collected and arranged. In the mean time, we are desirous of calling the attention of geologists to it by noticing, very shortly, the opinions of the few who have written any thing in this wide field of inquiry.

M. de Saussure, during his examination of the Alps of Switzerland, was forcibly struck with the appearance of blocks of granite, which had evidently belonged to the central ridge, lying scattered on the surrounding mountains and on the neighbouring valleys. To remove these blocks from their parent rock, and to transport them across deep and wide ravines, and over the summits of intervening mountains, seemed to require an agent of no ordinary power. The transportation of these blocks, Saussure ascribes to a vast torrent, which he imagined had, at a remote period, swept the earth, overtopping the Alps, and carrying masses of the rocks along with it. To this supposed torrent he applies the term *debacle*, a French word which is sometimes made use of to denote the clearing of a harbour, by setting at liberty a collection of water to sweep away the alluvial matter obstructing it. Our English word *deluge*, we consider more expressive of the extent of such a torrent as would be necessary to produce the effects in question.

While De Luc admits the *debacle* of Saussure, he ascribes the position of the blocks of granite to a cause which could have a place only in the most fantastic imagination, and which it is needless for us to detail. Neither of these philosophers appear to have digested their ideas of a deluge so perfectly, as to warrant their entering on any explanation of its cause, or even affording any precise idea of their notions respecting its operations when produced. Pallas, in his *Observations sur la formation des Montagnes*, ascribes the production of the deluge, which he supposes to have transported the remains of animals of one climate to another, to the action of volcanoes under the sea.

These speculations have remained almost unnoticed till lately, when Sir James Hall brought the subject before the Royal Society of Edinburgh, in a form more likely to attract attention. That gentleman has for many years been engaged in tracing what he conceives to be the effects of a powerful torrent, that has swept across Scotland from west to east. He has hitherto confined his researches to the vicinity of Edinburgh; and has accurately pointed out various places, where scratches and furrows on the surface of the rock are to be seen, and which are worthy of minute examination. These effects he ascribes to the attrition of the stones carried along by a deluge. Whoever examines the deep mass of gravel, sand, stones, and clay, which, in almost every country, covers the surface of the rock, acknowledges immediately that it has been deposited by water. But with respect to the manner in which the water operated, different opinions are entertained.

This subject does not seem to have been of sufficient importance to arrest the attention of the Wernerian school. The followers of Hutton are divided on this question; and while some of them assert, that the ordinary diurnal operations of the atmosphere and the action of rivers, are sufficient to account for all that has been observed, others maintain, that something more is required.

Sir James Hall appeals to the efforts of subterraneous heat acting under compression, as supposed by Dr Hutton, and endeavours to illustrate the mode in which he imagines a wave of sufficient magnitude to have been produced. We believe it to be now universally admitted, that concussions of the earth are occasioned by the exertion of an elastic fluid bursting the rocks which confine it. Sir James Hall supposes that such an exertion, by heaving up the superincumbent mass, and displacing a body of water, which is also impelled upwards by the concussion, would produce a wave on the surface of the sea. An earthquake felt on the coast, is commonly attended first with a retreat of the water from the shore; an effect which Sir James Hall accounts for, by the rising of the wave immediately above the place where the subterraneous force exerts itself. After this retreat, the water returns with great violence, and overwhelms every thing in its progress. These effects are illustrated by events during the earthquakes at Cadiz, Lisbon, and Callao. But the most remarkable, and the one which applies most strictly in illustration of Sir James Hall's ideas, is that related by Humboldt, of a large tract of ground, extending to three or four square miles, called the *Malpays*, in South America, having been raised, during an earthquake, to the height of 524 feet. This might have happened at the bottom of the sea, and there can be no doubt of similar events taking place in that situation.

Experiment has been resorted to by Sir James Hall; and by exploding gunpowder under water, he succeeded in producing in miniature, precisely the same effects which he supposed would arise from the concussion of an earthquake in the sea.

Having thus attempted to explain the means by which a vast wave, sufficient to overtop the mountains, might be raised, Sir James calls in the aid of glaciers, to assist in transporting large masses of stone from one place to another. It is well known that the glaciers of the Alps, and the Icebergs formed every winter at the mouths of the great rivers in the northern regions of America, envelope immense collections of stones. It is supposed that if a torrent of water broke it up, the ice would float along with its load, and deposit it gradually as it advanced and melted. The extraordinary blocks of granite on the shores of the Baltic may thus, it is supposed, be accounted for, as well as those of the Alps.

We do not intend at present to discuss the hydrostatical accuracy of Sir James Hall's theory. But we may state, that an operation, the very reverse of that which he supposes, would produce a wave without any deviation from the laws of hydrostatics, and account for all the appearances observed during earthquakes. Instead of the land rising, we may suppose it to burst, and lay open extensive hollows, into which the water would rush, filling up the vacuum occasioned by the escape or condensation of the elastic vapours which caused the fracture. Powerful currents would immediately be produced, all tending to a centre; and the velocity acquired would be such, that, after the vacuity was filled, the collision of so many currents at one point, would raise the water to a great height. The retreat of the water from the shore might be explained as well in this way, as by supposing the bottom of the sea to have been raised. The heaving of a mass of land entirely out of the sea, or its sudden submersion, would also produce great agitation in the water; and in every case the operation of subterranean heat in producing elastic vapour, might be retained.

Professor Playfair, the able illustrator of the Huttonian theory, differs widely from all those who are disposed to call in the aid of extraordinary causes and effects, to account for the enormous collection of loose, heterogeneous materials which, for the most part, form the surface of the land. At the time when Mr Playfair wrote, the subject had not been fully stated by any of the partisans of a deluge; and he acknowledges that he has been combating an unseen enemy. Sir James Hall has now stated one side of the question; but he has not by any means exhausted the facts and arguments which tend to corroborate the opinion, that a deluge has swept the face of the earth, and caused that arrangement of the surface which we now observe. We intend to prosecute an examination, already begun, of some districts in which facts illustrative of this subject abound; and we hope in a future article to give a more ample and distinct view of the subject, than it admits of at the present time. The chief object of research ought first to be, to discover whether, in reality, there exist any facts which seem to owe their origin to some extraordinary operation of water; and when such an operation shall be deemed necessary, it will be time enough to make attempts to reconcile it with natural causes and effects.

We close this brief notice with stating a fact which seems to have escaped the observation of diluvian speculators, and which is doubtless of no small importance in the question concerning the animals whose remains are found in northern climates, having belonged to one farther to the south. If we suppose that a torrent has swept the earth, we should expect to find the exuviæ of the human race, as well as those of inferior animals. But this has never occurred, even to the observation of the indefatigable Cuvier; and the alternative is, that the human race did not exist at the time when the supposed catastrophe happened. See Saussure's *Voyages dans les Alpes*, vol. i.; Pallas' *Observations sur la formation des Montagnes*, p. 71, Petersbourg, 1782; *Nov. Comment. Petropol*, tom. xvii. p. 576.; De Luc *Lettres sur l'histoire physique de la terre*, p. 233, &c.; Playfair's *Illustrations of the Huttonian Theory*, p. 412; Cuvier's *Essay on the Theory of the Earth;* and Sir James Hall *On the Revolutions of the Earth's Surface*, in the Edinburgh Transactions, vol. vii. p. 139—211. (S. K.)

DEMERARY, a settlement in Guiana in South America. The river Demerary, from which this settlement derives its name, after a north-easterly course of about 200 miles, falls into the Atlantic Ocean, in latitude 6° 50′ north, longitude 58° west from London. At its entrance, the river is a mile and a half broad, and is navigable for ships of considerable burden, for about 100 miles: well cultivated plantations adorn its banks for nearly another 100 miles inland; when the navigation is obstructed by cataracts, the wild and mountainous scenery of which, though forbidding to industry, attracts frequent parties of pleasure. A little above these cataracts, two streams unite to form the Demerary, the one flowing from the south-east, the other from the south-west, the sources of which, however, have not been explored by Europeans. The Demerary, sheltered from every wind, and never visited by those hurricanes, so frequent in tropical climates, forms one of the finest harbours in the world, and could contain with ease all the navy of Great Britain. Unfortunately, however, a bar of mud stretches across its mouth, over which no vessel drawing more than nine feet can pass until half flood: at high water in spring tides, the bar is covered to the depth of eighteen feet, but still requires very cautious navigation.

The country of Demerary, for many miles from the shore, consists of fine savannahs, in which not a mountain, hill, or even a mole heap occurs, to diversify the landscape. About twenty miles from the mouth of the river on its western bank, there are some hills of sand, from 100 to 150 feet high, and nearly perpendicular. In ascending towards the source, the country becomes more varied and mountainous.

The scenery along the banks of the river, though uniform, is pleasing. Plantations regularly ranged on either side; dwelling-houses built close to the river's brink; buildings of different descriptions, scattered without order in every direction; on the sugar estates, mills driven by wind, by water, or by cattle; on the coffee plantations, *logies* or barns, three stories high; form a very picturesque and beautiful prospect; while boats continually sailing up and down the river, give animation to the scene, and afford a favourable idea of the industry of the inhabitants. The plantations along the river, as well as in the other parts of Demerary and the adjoining colonies, were surveyed, and laid out in allotments of five hundred acres, by the Dutch West India Company; with a conditional grant of as much more behind the first, when two thirds of it should be cultivated: to this grant all the estates on the river are now entitled. Every plantation has a wharf, or landing place, opposite the dwelling-house; and is surrounded by canals, with sluices, for the double purpose of draining from the land all superfluous moisture, and of harbouring boats, while they are loading and discharging. Thus every estate is completely insulated; and for the convenience of travellers, a bridge is thrown over the canals on each side, which the proprietor is obliged to keep in repair, and to have painted white, that they may be discernible in the dark. The only articles of cultivation are sugar, coffee, and plantains, with a small quantity of cocoa and rice. Though the culture of rice was but recently introduced, no doubts were entertained of its success; and it was even hoped that, if encouraged by government, it would rival that of South Carolina, a country which Demerary strongly resembles in climate. The live stock on a Demerary farm consists chiefly of poultry, with a few sheep, oxen, and swine. Rearing stock for the markets, particularly horned cattle, is here very profitable; and the fine savannahs in the interior afford so excellent pasture, that there is every reason to hope that these colonies will, in a short time, rear such numbers of cattle as will prove an abundant source of wealth to the grazier, and an unfailing supply to the West India islands. It is on his sugar, however, that the planter chiefly depends. Of this valuable commodity, the soil of Demerary, when properly cleared and prepared, yields very abundant crops: and the rum distilled from the molasses is calculated to defray all the expences of a sugar estate. Eighty gallons of rum are expected from every hogshead of sugar; and the Demerary rum has a richness of flavour, which gives it as high a preference in the American markets, as Jamaica rum has in England.

Of the value of this colony, some idea may be formed from the following statement of the produce cleared from the port of Demerary, for the three first years after the last establishment of the British custom-house.

From the first of October 1803 to the 10th of September 1804, in 394 vessels,—19,638 hogsheads, 213 tierces, and 161 barrels of sugar; 4887 puncheons of rum; 46,435 bales of cotton; 9,954,610 pounds of coffee; and 311 casks of molasses.——From the 10th of September 1804 to the 5th of January 1805, in 71 vessels,—2161 hogsheads, 78 tierces, and 19 barrels of sugar; 504 puncheons of rum; 6318 bales of cotton; 439,520 pounds of coffee; and 311 casks of melasses. ——From the 5th of January 1805, to the 5th of January 1806, in 200 vessels—15,839 hogsheads, 213 tierces, and 429 barrels of sugar; 3611 puncheons, and 17 hogsheads of rum; 21,202 bales, and five bags of cotton; 2,295,701 pounds of coffee; and 1694 casks of melasses.——From the 5th of January 1806, to the 5th January 1807, in 221 vessels—19,337 hogsheads, 474 tierces, and 801 barrels of sugar; 4722 puncheons, and 17 hogsheads of rum; 23,604 bales, and two bags of cotton; 12,390,102 pounds of coffee; and 1694 casks of melasses.

While cultivation had yet made but little progress, the district of Demerary was deluged by frequent torrents of rain. As the land was cleared, the climate likewise was improved; and two wet and two dry seasons now mark the revolution of the year. Each of these seasons continues for three months. During the rainy seasons, which include the months of December, January, and February, and of June, July, and August, the thermometer is lower than at other times; the land-winds, which are deemed unhealthy, prevail; and the swarms of musquitoes are extremely troublesome. The dry season is extremely fine; the morning twilight commencing at four, gradually unveils a clear azure sky, which continues cloudless throughout the day; at six in the evening the sun sinks at once beneath the horizon, leaving the country in sudden darkness. This length of twilight in the morning, and the total want of it in the evening, may perhaps be occasioned by the sun's rising over the sea, where the atmosphere is very reflective, and setting behind high mountains, whose shadow has definite limits. From seven to ten the heat is almost intolerable; the sea breeze, then arising, restores nature to animation, and continues to blow with increasing vigour till sunset, but subsides about ten at night. During the months in which the West Indies are ravaged by hurricanes, Demerary is affected only by heavy squalls of wind, which do no other injury than blowing down a few acres of plantain trees. Clouds piled on clouds are now seen moving towards the south; hollow peals of thunder are heard in the interior; and the day generally closes with faint flashes of lightning from the south and south-west. The length of the day varies from thirteen to fourteen hours. The range of the thermometer on the sea coast in the dry season, which is the hottest, is from 84° to 90°; at the distance of twenty miles in the interior, the degree of heat seldom exceeds 80° in the warmest part of the day; and at night is generally as low as 50° or 60°.

An account of the diseases incident to this climate, and of its animal and mineral productions, will be given, with more propriety, under the article GUIANA.

The towns in Demerary are Stabroek, the capital; Kingston, an English village, first reared in 1796; Labourgade, consisting of a range of warehouses on the bank of the river; Cumingsburgh, a regularly built town about two miles in circumference; Bridge-town, and New-town; and the village or town of Werk en Rust. The houses in all these towns are generally built of timber on brick foundations, two stories high, and painted white.

Demerary, originally colonized by the Dutch, was wrested from them by the English in 1796; when a number of British adventurers resorted to it. The greatest respect was paid, however, to the existing laws, and to private property; the persons of individuals were held sacred; and even the floating property embarked in colonial vessels was secured to its possessors. This colony was rashly ceded at the peace of Amiens, to the serious injury of many British planters and merchants. It was re-taken in 1803; and it is to be hoped that no trifling consideration will induce ministers in future to relinquish a possession of such importance. (*k*)

DEMOCRACY. See GOVERNMENT.

DEMOCRITUS, a celebrated Grecian philosopher of the Eleatic School, was born at Abdera, a city of Thrace, about five hundred years before the Christian æra. He was one of the earliest propagators of the atomical theory; which was originally invented, it is believed, by his master Leucippus, matured into scientific form by the labours of Epicurus, and transmitted to posterity in the ingenious philosophical poems of Lucretius.

The circumstances of the life of Democritus are inextricably involved in the impenetrable obscurity of ancient fabulous traditions; indeed, if we except Pythagoras, there is none among the Grecian philosophers, to whom so many marvellous acts, so many follies, and so many absurd writings are ascribed. Like most of the early sages of Greece, he is said to have travelled, in quest of knowledge, into the remotest regions of Asia and Africa; and having, at length, by means of his extensive travels and observations, acquired a vast accumulation of general and profound science; he determined to fix his abode at Athens. To this city, therefore, he repaired, and voluntarily surrendering all his property to the state, reserved to himself only a small garden, where he devoted himself to privacy and contemplation. The most hidden *arcana* of nature, it is said, were developed to his penetrating eye, and antiquity boasts of the miracles he performed, by means of the powers with which his knowledge supplied him, as well as of the predictions by which he astonished his contemporaries. His whole life, we are told, was devoted to the investigation of the properties of herbs, minerals, and other productions of nature; and with the view of prosecuting his researches undisturbed, he is reported to have retired into the dwellings of the dead. At the same time, it is somewhat inconsistently related of this indefatigable observer of nature, that he was mad enough to tear out his own eyes; and although withdrawn from the society of his fellow-creatures, that he constantly laughed at the follies of mankind. All these absurd stories were faithfully recorded and implicitly believed by the most eminent Greek and Roman authors; and in the first ages of Christianity, Democritus was generally considered as one of the earliest professors of the art of magic. The eccentricities of this philosopher, we are informed upon no less doubtful authority, induced a belief among the vulgar, that he was disordered in his mind; but Hippocrates, the celebrated physician, being sent to cure him, soon discovered the mistake, and found him to be one of the wisest men of the age.

Democritus was one of the earliest and most successful experimental philosophers; and to his proficiency in science he was probably indebted for his reputation as a magician. So ardently was his mind engaged in the pursuit of knowledge, that he is said to have declared he would prefer the discovery of one cause in the works of nature to the possession of the Persian monarchy. His opinions in regard to the origin and formation of the world, were nearly the same with those which had been previously held by his predecessor, Leucippus. Matter, which he considered as self-existent, he supposed to have been originally divided into an infinite multitude of primary or elementary particles, of which some were eternally intelligent, while others were eternally senseless and incogitative; the latter being incapable of resisting the action of the former, by whose union with them, and controul over them, the visible world was produced. This theory, in the hands of Epicurus, afterwards assumed a more rational and scientific form. See ATOMICAL PHILOSOPHY. In astronomical science, Democritus made some important observations and discoveries. He was the first who taught, that the whiteness of the milky way was occasioned by the confused light of an infinity of stars; an explanation of that phenomenon which was adopted, in later times, by Dr Herschel. And he maintained, though upon erroneous principles, that more planets existed than had been hitherto discovered; a conjecture which has been verified by the observations of astronomers, after an interval of many centuries. In chemistry, Democritus appears to have made successful experiments and researches; several inventions being ascribed to him, which argue no inconsiderable progress in chemical science.

Democritus lived to a very advanced age; and the circumstances attending his death are thus recorded by the ancient writers. Some time prior to his decease, his friends seeing him suddenly reduced to a state of extreme debility, became apprehensive that his end was at hand. His sister, who was at that period engaged in celebrating the festivals of Ceres, declared, that if he then died, she should not be able to perform her vows; upon which the philosopher requested her to supply him with cordials of a particular description, which prolonged his life until her religious rites, which occupied three days, were completed; and when that time had expired, Democritus, exhausted by the pains he endured, hastened, by his own act, the slow approach of death,—

Sponte sua leto caput obvius obtulit ipse;

thus, by his example, giving sanction to a practice, which, although reprobated by the more enlightened doctrines of Christianity, was neither unusual nor accounted criminal among the sages of antiquity. See Meiners, *Geschichte d. Wissensch. in Griechenl, u. Rom.*; Brucker; Bayle; and Mason Good's *Lucretius.* (z)

DEMON. This word is of Greek origin, and is supposed to come from the verb δαιω, the primary meaning of which appears to have been, that of separating into parts, by cutting instruments or other violent means. Hence the verb just mentioned signifies to divide, to distribute, *to reduce by fire*, and following out the idea of separation into parts, to examine in detail, to search, to learn. In conformity with these statements, the word demon will signify a being, who assigns to man his *portion* of enjoyment or of suffering, (παρὰ τὸ δαῆναι τὰ παντα, η μεριζειν τὰ ἀγαθὰ ϗ κακα τοῖς ἄνθρωποις, Proclus in Hesiod,) or it will signify an agent superior to human beings in respect of intelligence, and that species of efficiency which is connected with the possession of knowledge. In some of the Greek writers, the phrase ὁ δαιμων, and the corresponding phrase τὸ δαιμονιον, are used to signify the divinity in general "τὸ θεῖον, *deus supremus, et divinitas mundi moderatrix.*" ὁ δαιμων appears occasionally to be used in this sense by Xenophon, in the *Memorabilia* of Socrates. τιμα τὸ δαιμονιον is a well known precept of the ancient moralists; and Plutarch in *Galb.* says, that thunder and lightning proceed "απο τȣ δαιμονιȣ" from the divinity. The word demon appears next to have signified any one out of the number of the gods. It is applied in this sense to Venus, *Iliad*, iii. and in *Iliad*, xvii. line 98, 99, compared with 104, we find an instance where δάιμων and θεος are used by the poet as equivalent expressions:

Ὁππότ' ἀνηρ ἐθελει προς δαιμονα φωτὶ μάχεσθαι
Ὅν κε θεος τιμᾷ, ταχα οἱ μεγα πημα κυλίσθη·

The word in question seems next to have been applied exclusively to the inferior divinities, or those called the *Dii indigetes, sive minorum gentium.* In this sense θεος is distinguished from δαιμων, and hence the phrase in common use among the Greek writers, θεοὶ ϗ δάιμονες. Of the sense now under consideration, we have a remarkable example in the oration of Æschines against Ctesiphon, 'ὦ γη (says the orator) ϗ θεοι, ϗ δάιμονες ϗ ἀνθρωποι, ὅσοι ϐȣλεσθε ἀκȣειν ταληθη'· In the progress of thought and of language, the idea implied in the term demon appears to have been farther reduced, and the word seems to have been employed to denote a certain class of beings not very well defined in their attributes and character, but considered as holding an intermediate place between gods and men, and corresponding to what in modern times we should denominate *genii*, (simones, quasi semi homines, minores diis, et majores hominibus, *Liv.* viii. 20. Adam's *Rom. Antiq.* p. 287). These of course were either benignant or malign, the δαιμονες κακοι, or πονηροι, and the δαιμονες αγαθοι. The word appears to have this sense in such phrases, as "the demon of the king," the "demon of Socrates," and perhaps too, it was used in this sense, when Parrhasius was said to have painted allegorically the genius (demon) of the Athenians, representing it according to Pliny, as "varius, iracundus, injustus, inconstans," *Nat. Hist.* xxxv. 36. In a still greater reduction of the idea, the word demon is used as equivalent with *fortune*, viewed in the light of a presiding power; hence the phrase καλα δαιμονα, *omine fausto, prospera.* And last of all, we find it employed in the sense of casualty, or chance in life.

In the books of the New Testament, both the words, which are properly rendered demon, namely δαιμων and δαιμονιον, are to be met with; and δαιμονιον in particular is of very frequent occurrence. Neither of them is well translated by the term *devil.* This last word is the proper version of διαϐολος, when applied to the chief of the apostate angels, but not of δαιμων, or δαιμονιον. Indeed our translators themselves appear in some instances to have been sensible of this; for in the account which is given of the effect produced by the preaching of St Paul at Athens, they have rendered the words "'Οι δε ξενων δαιμονιων δοκει καλαγγελεῦς ἔιναι," by "Others said, He seemeth to be a setter forth of *strange gods;*"—Jesus and the resurrection (Ιησȣς ϗ Αναστασις) being taken for new divinities, the one a male and the other a female. The propriety of this version is abundantly evident. Had our translators followed their usual practice, and rendered the words, "He seemeth to be a setter forth of *strange devils,*" they would not only have perverted the meaning of the original text, but would have represented these Athenians to the English reader in a light most truly ridiculous. Ingenious men, or men possessing a certain share of natural acuteness, though unacquainted with the Greek language, might have proposed their solutions; but the common reader must have remained for ever at a loss to conceive, how Jesus and the resurrection, allowing that the Athenians regarded the one of these as a male divinity hitherto unknown to them, and the other as a female, could, with any measure of propriety or of decency, be called *strange devils.* Our translators, therefore, have done wisely in rendering *ξενων δαιμονιων*, by "strange gods." Nor are there wanting other examples in the books of the New Testament, where the Pagan divinities are mentioned under the name of demons. (See 1 Cor. x. 20. and Rev. ix. 20.) In general, however, the demons of holy writ are malignant spirits. We are not informed very particularly about their origin or destiny, but we find them represented as *πνεῦματα ἄκαθαρτα*, and *πνεῦματα πονηρα*, unclean and evil spirits, and according to the received opinion, we must consider them as in league with the devil, (Ὁ *διαβολος*, ὁ *Σατανας*, ὁ *Δρακων* ὁ *μεγας*, &c.) as the subjects of his dominion, and the instruments of his will. They were the immediate agents in all possessions, and to expel or restrain them, or to cure the diseases which they were supposed to occasion, was one of the miraculous gifts of the early times.

The reader who is acquainted with the subject, will perceive that we are now on the borders of the controversy which was agitated about the middle, and towards the end of the last century, by Dr Farmer and his opponents. In the controversy alluded to, of which we shall attempt to give a short account, it was contended, on the one hand, that the demoniacal cases recorded in the books of the New Testament, were instances of real possession; and on the other, that they were merely diseases, set forth under the notion of possessions, in conformity with the belief which was prevalent at the time. By the one party, the language of holy writ was interpreted literally; and by the other it was considered as figurative, and used in the way of accommodation to the existing opinions. We shall not pretend to decide this controversy, but shall rather endeavour, as candidly and impartially as possible, to furnish our readers with the means of deciding it for themselves.

The leading asseveration of Dr Farmer upon the general question, is, that miracles, or works surpassing the power of man, are never performed without a divine interposition; and by a divine interposition he means, either the immediate agency of the Deity himself, or of beings empowered and commissioned by him, And the proof of this asseveration, he tells us, may very easily be found, if we consider, that on any other supposition, it is impossible to shew that a religion supported by miracles is really from God. For the miracles in question, or works surpassing the power of human beings, may have been performed by evil spirits, acting independently of the Divinity, thwarting his purposes, and marring the operation of his goodness. Should it be said, that, from the tendency of the miracle itself, and *a fortiori*, from the tendency of the miracle and religion when taken together, we may easily infer the character of the being from whom the whole scheme proceeds,—to this also Dr Farmer is ready with his answer. "With regard to doctrines," says he, "of a moral or useful tendency, it is not, in all cases, easy for the bulk of mankind, or even for the wise and learned, to form a certain judgment concerning them. What to men appeared to have a tendency to promote virtue and happiness, superior beings, who discerned its remotest effects, might know to be a curse rather than a blessing, and give it countenance from a motive of malevolence. On the other hand, a doctrine really subservient to the cause of piety and virtue, men might judge to be prejudicial to it. And were the sanctity of the doctrine ever so evident, it would not (on the principles of those with whom we are here arguing) certainly follow from hence, that the miracles recommending it were wrought by God; inasmuch as other beings, from motives unknown to us, might interest themselves in favour of such a doctrine." *Essay on Miracles*, p. 87. In one word, according to this author, we do not know whether the tendency of the miracle or of the religion be good or not, and therefore we can form no accurate idea of the character really belonging to the being from whom the revelation proceeds. To our eyes, the system may appear well calculated to promote our happiness, but it may have been the contrivance of wicked spirits. According to the sense and discernment of men, the miracle is useful in itself, but we cannot be sure whether it may not have been performed by one of the rebellious angels "who kept not their first estate." In conformity with these opinions, Dr Farmer maintains, that there is not an instance recorded in sacred scripture, where a miracle has been wrought, and where there is not sufficient reason to believe, that the effect was produced, either by the Deity himself, or by agents commissioned and impowered to act in his name. Hence he considers the Egyptian magicians as jugglers; the witch of Endor as a ventriloquist; and completing the system, he has written an elaborate dissertation to prove, that when Christ was "tempted of the devil," as the Evangelist Matthew expresses it, that apostate angel was not really present, and that the whole transaction took place in a vision or a dream.

With regard to the demoniacs of the New Testament, Dr Farmer observes, that among the Jews, certain diseases, such as madness and epilepsy, were usually ascribed to the agency of evil spirits. This was the current notion and belief of the country. Upon this notion the ordinary phraseology was built. Our Lord and his apostles adapted their instructions to this prevailing notion, and used the language which had been formed upon it, just as Moses, in his account of the creation, adapts himself to the popular astronomy of his time, instead of laying before us the true system of the heavenly bodies. He speaks, not in relation to what is physically correct, but in relation to what was believed. He founds his instructions upon the ideas already entertained by the people to whom the revelation was first communicated: And Christ and his apostles (as Dr Farmer will have it,) do the very same thing. They speak of the demoniacs, not according to the real state of the case, but according to the notions which the Jews entertained of it. Not a few of those demoniacs appear to have been persons of a disordered understanding, subject to attacks of *mania*; some of them were afflicted with the epilepsy, or falling sickness, some were deaf, and others were dumb. When a demon is said to enter into a man, the meaning is, that his madness is about to show itself in a violent paroxysm; when a demon is said to speak, it is only the unhappy victim of the disease himself that speaks; and when a demon or devil is expelled, the exact truth of the case, as well as the whole amount of the miracle, is nothing more, than that the disease is cured. Occasionally, too, say those who contend against the reality of demoniacal possessions, the language of the sacred books confirms the explanation which has just been given. Thus in the 10th chapter of St John's gospel, we find the Jews saying of Christ, "he hath a devil and is mad," as if the expressions were perfectly equivalent. And the person who is represented, in the 17th chapter of Matthew as a lunatic, is spoken of by St Mark as vexed with a dumb spirit. "Besides," says Dr Campbell, (though he held an opinion upon this subject very different from that of Farmer,) "it was a common idiom among the Jews to put *spirit* before any quality ascribed to a person, whether it be good or bad, mental or corporeal. Thus, the spirit of fear, the spirit of meekness, the spirit of slumber, the spirit of jealousy, are used to express habitual fear, &c." *Translat. of the Gospels*, vol. i. p. 251. ed. 1803.

It is farther urged on this side of the question, that the instances of possessions recorded in the books of the New Testament, have all the features and appearance of ordinary diseases. The madness shows itself in these cases, just as it shows itself in the cases which occur among ourselves in the present day: it is now melancholy, and the patient is silent and sullen, and now it vents itself in bursts of anger and ferocious resentment. And the epilepsy of the sacred books is the epilepsy of all our systems of nosology; the phenomena of the diseases are precisely the same. Nor does this detract (in the opinion of Dr Farmer) from the very high character which Christ undoubtedly sustains in the inspired writings, or diminish the value of his miracles as the evidences of our religion; since it must be allowed, that to cure a disease with a word or a touch, is an effort of power, far beyond the reach of any human being. And let it be remembered, that those who deny the expulsion of demons, are ready to admit that diseases were miraculously cured. There is a miracle in either case; and in either case, it is a sufficient proof of our Saviour's mission, and an adequate support of the Christian faith.

To these statements and reasonings, the advocates of possessions have not been slow to reply. Indeed, on every inch of the ground to which the preceding observations refer, they declare themselves willing to join battle with their antagonists. They call in question the truth of Dr Farmer's leading asseveration, namely, "that extraordinary works have never been performed without a divine interposition," and contend, that as human beings have a certain sphere and agency allotted them, so it is reasonable to believe that malignant spirits have a wider sphere and an agency less controulled; and that within this sphere, and in the exercise of this agency, they perform actions, the tendency of which is to thwart the purposes of the divine beneficence, and to introduce confusion and misery into the world. They argue too, that the devil himself, the chief of the apostate spirits, is often represented in holy writ, as exerting his malignity in opposition to the designs of infinite goodness; and in the case of our first parents, as a remarkable example, he tempted them to disobedience, and led them to their fall. It was in consequence of his machinations, that they brought down upon themselves the wrath of heaven, and were driven from the garden in which "the Lord had placed them." The advocates of possessions contend still farther, that the revelation which is made to us in sacred scripture is addressed to our understandings; that it is not only in our power, but that it is our indispensible duty to examine it, and to judge of it; that the tendency of any miracle, or system of doctrine, is a sufficient evidence of the character belonging to him who performs the miracle, or publishes the doctrine; that good actions are demonstrative of the quality of goodness; and, in short, that a religion calculated to make us happy, must have proceeded from a being who has consulted and provided for our happiness. Nor is this a matter so abstruse and remote from human apprehension, that we can form no opinion about it. For, say they, if any thing connected with Christianity be plain, it seems to be, that the tendency of the religion is beneficent, and that it is no less pure in its character than blessed in its effects. The very miracles recorded in scripture are proofs of goodness. They must have been wrought by a good being. And (they continue) we think ourselves entitled to hold our religion as true, and to regard it as in the highest degree beneficial, though we might allow, at the same time, that the magicians of Egypt performed many wonderful works by the agency of wicked spirits, that the sorceress of Endor was in league with the powers of darkness, and that Christ was literally tempted "of the devil," in the wilderness of Judea.

With regard to the more specific question of demoniacal possessions, they are equally bold. They assert, that though God has often been pleased to accommodate himself to our apprehension, by adopting the current language of the countries where the revelation was first published; yet the account of the creation given by Moses is not altogether an instance in point. For (say they) while it is granted that the true system of the universe is not laid before us in the first chapter of Genesis, it ought to be remembered that the statements in that chapter are exceedingly general; and that, while the whole truth is not told, it being no part of the revelation to tell it, there is, at the same time, no error directly inculcated. In the demoniacal cases, however, the conduct of the inspired writers, and indeed of Christ himself, is widely different. They positively and directly inform us, that a demon "enters into" a man, and "comes out" of him; they represent the demons as speaking and reasoning, and hoping and fearing; as having inclinations and aversions peculiar to themselves, and distinct from those of the person who is the subject of the possession; they tell us of one unhappy sufferer who was vexed with many devils; and, in the case of the demoniac of Gadara, they assure us, that the devils were "cast out" of the man, and were permitted, at their own request, to "enter into" a herd of swine which were feeding in the neighbourhood, and that immediately the herd ran violently down a steep place, and were drowned in the sea. Who ever heard of swine afflicted with madness as a natural disease? Or when and where has the epilepsy, or falling sickness, been predicable of the sow? For (say the patrons of possessions) it must be carefully observed that the disease of the man, the affection of the human sufferer, whatever that affection might have been, was clearly transferred from him to the animals in question. Besides, as various instances are recorded in scripture, and as several of these instances are given at considerable length, might we not expect, if possessions were really nothing more than ordinary diseases, that the truth would be somewhere told or hinted at? that, within the compass of the sacred canon, something would be said, or something insinuated, which would lead us to understand, that the language, though inaccurate and improper, was used in accommodation to the popular belief? Might we not expect that Christ himself would have declared, in one unequivocal affirmation, or in some intelligible way, the exact truth of the case? Or, at all events, when the Holy Ghost had descended upon the apostles on the day of Pentecost, and when the full disclosure of the revelation appears to have been made, might it not reasonably have been looked for that the popular error would have been rectified, and the language reduced from its figurative character to a state of simple correctness? What conceivable motive could influence our Saviour, or his apostles, to sanction the delusion of the multitude? And does it not strike at the root of the Christian religion itself, to have it thought, for a single moment, that its "author and finisher," who came to enlighten and to reform the world, should have, on so many occasions, not only countenanced, but confirmed, an opinion which he must have known to be "the reverse of the truth."

Let us beware, (say the antagonists of Farmer,) how we relinquish the plain and literal sense of holy writ, in search of allegorical or figurative interpretations. And if, upon any occasion, we think it proper to do so, let us consider well the grounds and reasons upon which our determination is built. It is evident (they affirm) that the devil and his angels, according to all that we can learn of them in the sacred books, are real beings, that the demons of the New Testament are malignant spirits, and that they act upon the same principles, and even under the authority of Satan himself, who is otherwise called Beelzebub, and the Prince of the Devils. Nay, in these very cases of possession, the chief of the apostate angels is clearly set forth as acting either in his own person or by means of his infernal agents. And it is on this supposition alone that we can explain the language of Christ in that remarkable declaration which he makes to the Pharisees and rulers of the Jews, and which we find recorded in the 12th chapter of the gospel by Matthew. "The Pharisees heard it," observes the evangelist, "and they said, This *fellow* doth not cast out devils but by Beelzebub, the prince of the devils. And Jesus knew their thoughts, and said unto them, every kingdom divided against itself is brought to desolation, and every city or house divided against itself, shall not stand: And if Satan cast out Satan, he is divided against himself, how shall then his kingdom stand?"

A principal argument with those who contend for the reality of demoniacal possessions is, that the inspired writers uniformly make a distinction between diseases occurring in the ordinary course of nature, and diseases occasioned by the agency of evil spirits. This argument seems to be regarded as conclusive by Dr Porteous, Bishop of London, in his Lectures on the gospel of St Matthew. He represents the distinction alluded to as plain and frequent. "There is every where," says he, "a plain distinction made, between common diseases and demoniacal possessions; which shows that they are totally different things. In the 4th chapter of this gospel, (St Matthew,) where the very first mention is made of these possessions, it is said that our Lord's fame went throughout all Syria, and that they brought unto him *all sick people*, that were taken with divers diseases and torments, and those *which were possessed with devils*, and he healed them. Here those that were taken with divers diseases and torments, and those possessed with devils, are mentioned as distinct and separate persons: a plain proof that the demoniacal possessions were not natural diseases; and the very same distinction is made in several other passages of holy writ. There can be no doubt, therefore, that the demoniacs were persons really possessed with evil spirits; and although it may seem strange to us, yet we find from Josephus and other historians, that it was in those times, no uncommon case." See *Lectures on St Matthew*, vol. i. p. 264.

Such is a concise view of the argument on both sides of this abstruse and difficult question. We are not aware that we have misrepresented, in any material circumstance, the sentiments of either party. But the subject of this article is by no means exhausted by what we have said. It remains for us to treat of the demonology of the middle ages, and the influence, real or supposed, of wicked spirits, in more modern times. But for some curious information on those topics, we refer to another part of our work. See WITCHCRAFT. On the subject of the present article, our readers may consult the following works of Dr Farmer: *Essay on Miracles; Essay on the Worship of Human Spirits; Essay on the Demoniacs of the New Testament;* and the *Essay on our Saviour's Temptation in the Wilderness.* Also Campbell *On the Gospels, Prelim. Dissert. art.* δαιμονιον. Jortin's *Remarks on Ecclesiastical History*, vol. i. Lardner's *Works*, vol. i. edit. Kippis. Sykes's *Inquiry*, passim. Mede's *Disc.* vol. vi. p. 28. Mead's *Medica Sacra*, c. ix. Warburton's *Sermons*, vol. iii. p. 213. Pegge's *Answer to Sykes.* Doddridge's *Family Expositor*, vol. i. p. 372. note g. Lightfoot's *Horæ Hebraicæ, on Matt.* viii. 28. (*h*)

DEMONIACK. See DEMON.

DEMOSTHENES, the Athenian orator, was born in the 4th year of the 99th Olympiad, and 381 years before Christ. His father was an Athenian born, but his maternal descent was partly Scythian. The Athenians had proceeded from trading with the natives, to form a settlement on the shores of the Tauric Chersonese, now called the Crimea. Gylon, an Athenian, was, under the appointment of his own republic, governor of this settlement or fortified factory, when the sovereign of the country desired to regain possession of it. Despairing, however, of being able to carry it against the skilful fortifications of the Greeks, he entered into a negociation with the governor, who, for the bribe of a town and territory, and the promise of a rich Scythian heiress in marriage, surrendered Nympheum to the barbarous potentate. Of course he could no longer appear at Athens, but possibly hoping to form some connections in his native city, so as to open a way for his pardon, he sent his two daughters to Athens. One of them married a man of eminence, Demochares; the other took for her husband Demosthenes, a citizen of the Pacanian ward, by trade a sword-cutler, and the father of the chief of orators. Demosthenes was left an orphan at seven years of age, with a very delicate constitution, but with a fortune, which, though it might have been partially dilapidated by his guardians, was still sufficient to rank him among the wealthy. According to the general account, his education was neglected. Mr Mitford, in his recently published and valuable history of Greece, has made it certain, from the orator's own authority, that he was not, as Plutarch represents him, illiterate at the commencement of his professional studies. Educated, says that author, (Mr Mitford) as became his fortune, and introduced into life advantageously through his connection with Demochares, he was of course to take his share of the combined toils and honours, which the Athenian constitution made the lot of the wealthy. In earliest manhood, he was appointed to the expensive but honourable offices of Choregus, or president of theatrical entertainments, and trierarc or director of the equipment of a ship of war. To the burden of this office was annexed the honour of the command of the ship equipped. But while none of the wealthy were legally excusable from the one, many would be very unfit for the other, which, therefore, was not so rigorously imposed. Demosthenes, though apparently little of a seaman, acted however at one time as a naval captain in the Athenian service. He contributed also to the treasury, as we find him boasting, by a gift called free, but no more to be avoided than the office of trierarc. Through his disposition to luxury and ostentation, (continues the same historian), his fortune was quickly dissipated. On emerging from his minority, (by the Athenian law at five-and-twenty,) he earned an opprobrious nick-name by a prosecution of his guardians, which was considered as a dishonourable attempt to extort money. In fixing this last stain upon Demosthenes' character, with regard to his prosecution of his guardians, Mr Mitford seems to give way rather to his systematic hatred of the republican orator, than to the force of historical evidence. The charge of youthful effeminacy in dress and manner, and even of prodigality, brought against him by his rival Æschines, might or might not be true; but in order to substantiate the accusation of baseness in his plea with his guardians, some better proof is required than the invective of a rival. The fact of his prosecuting those guardians is admitted; and the commonly received account is, that he cast them in damages. Had the decisions of the court of justice been against him, we should have been informed of it by the same hostile channel through which the suspicion of his motives has been conveyed. In the same uncandid spirit, we consider the general moral portraiture of this illustrious man to have been drawn by Mr Mitford. That his life was not unblemished, is but too evident; but to admit the abuse of Æschines as decisive in every instance against it, is the excess of historical acrimony; the more to be regretted that it comes from the pen of a writer so powerful, acute, and learned, as the latest historian of Greece must be confessed to be.

At the age of twenty-five, Demosthenes commenced that employment which had raised Isocrates before him to wealth, consequence, and fame, that of composing speeches for suitors in the court of justice; and from private causes, soon embarked his talents in those of the public. His natural deficiencies for public oratory, and the pains which he took to correct them, are related in almost every sketch of his biography. Some of them are akin to the marvellous, and savour much of the gossipping credulity of Plutarch; in particular, the anecdote of his mode of curing defective articulation, by speaking with pebbles in his mouth as he walked up a hill. Yet the tradition of antiquity, that he conquered impediments and acquired excellence by unbounded assiduity, may well deserve belief.

As Demosthenes was one of the great men who chain the history of their country to their biography, it may be necessary to say something of the circumstances of Athens at the time when he appeared as a public character. From the date of the glorious victories over the Persians, the Athenians, who assumed to themselves the chief honours of those victories, set up as the sovereign umpires of Greece. Their rivalship with Sparta occasioned the Peloponnesian war; after which, the Spartans, for thirty years, established a sovereignty over the petty states, that was much more intolerable than that of Attica. By the aid of Persia, however, Athens was enabled to form a new confederacy for the nominal independence of the Greek states, or, in other words, to transfer their dependence to themselves. They rebuilt their walls, and once more dictated terms to Sparta. Peace had not been long established, when Thebes, under the genius of Pelopidas and Epaminondas, rose to primary importance in the scale of Greece: in her short struggle against both Lacedemon and Athens, she gave a mortal wound to the supremacy of the former power, though she left the power of Athens comparatively unimpaired. Soon after, Olynthus, a city extending its influence widely over the Chalcidic continent, rose also to a formidable degree of consequence, and for a certain time gave a check to the Athenian arms. But the consequence of either Thebes or Olynthus was transitory, compared with that which was now developing itself in Macedon under Philip. Macedon, remote and rude, had hitherto been scarcely numbered among the Grecian nations; but its new sovereign Philip, who had been educated in the Theban school of arms, submitted its barbarous energies to a system of military and political tactics which proved irresistible. Philip, on his accession to the throne, found himself at war with Athens, which supported another competitor to the Macedonian throne. Having defeated the Athenians, he instantly liberated all the prisoners of that nation, and, by a politic act of generosity, sent them home, not only without ransom, but loaded with favours. Peace and alliance were concluded between the republic and Macedon, whose sovereign waved his pretensions to Amphipolis, a city bordering on Macedon, knowing it to be a favourite object of Athenian ambition. By the peace with Philip, Athens revived in political eminence; but the defects in her democratical constitution were coming to a fatal crisis, in the unsteadiness of government, the decay of patriotism and principle, and of military virtue, and in the subserviency of administration to popular passion. Victory, however, for a time attended the Athenian arms, which were turned, for a while, in conjunction with those of Philip, against the state of Olynthus. The alliance of the Athenians and Philip was broken off by events which are still involved in some obscurity, notwithstanding the generally luminous researches of Mr Mitford. According to that author, the whole blame rested on the Athenians, who turned short upon their ally, and with successful treachery instigated the inhabitants of Pydna, (a sea-port town subject to Macedon,) to revolt from Macedon. After which, the Athenians, having refused satisfaction to Philip, seized upon Amphipolis, and with some difficulty succeeded. Two points in this statement are, however, uncertain; the first is, the successful treachery of the Athenians in detaching Pydna from Macedon, which is but very obscurely intimated by the ancients; and, secondly, the fact of the Athenians having seized Amphipolis, of which there is no proof, although it is certain that they attacked it. In about a year from this time, Amphipolis was attacked by Philip, and the Olynthians now at peace and in alliance, were quickly taken. Diodorus's account, however, so far justifies Philip, as it informs us, that this prince had received strong provocation from the city of Amphipolis; and the Athenians, who had no more real title to Amphipolis than the Macedonians, could with an ill grace blame another power for taking possession of what they had themselves attempted to seize. Athens, however, whether her quarrel with Philip was just or unjust, was unable, for the present, to follow the dictates of her resentment. Her maritime oppressions had driven the states of Rhodes, Chios, Cos, and Byzantium, to join in a confederacy for independence, and to declare that they would protect their commerce with their own fleets, and pay no more tribute to that of Athens. This revolt, or, as it was called, the Social War, lasted for three years, and was succeeded by the Phocian, or Sacred War; so called, as it began from a motive or pretence of religion. The Phocians had ploughed up some ground adjoining to the temple of Apollo, at Delphos, which their neighbours and the Amphyctionic council denounced as an act of sacrilege. The Phocians resisting their decree, took up arms to assert their claim to the land. Athens and Sparta declared on their side. The Thebans were their principal opposers.—These were some of the principal public events connected with the field of politics on which Demosthenes was to act so conspicuous a part. It would be digressing too far into the history of Athens, to enter into other circumstances of nearly coeval date, which are connected with the subjects of his orations; such as the politics of Eubœa and Thrace, in which the contending ambition of Philip and the rival republic were vigorously engaged. Two parties now divided the Athenian councils; one perpetually recommending peace and friendship with Macedon, the other breathing only war and views of aggrandisement. The former might consist partly of the secret adherents of Philip, but it also contained a few patriotic men, far above suspicion, of whom were Isocrates and Phocion. At the head of the high democratical war-party was Chares, who bore the most extensive influence over the sovereign and tyrannous many.

Demosthenes was but yet a candidate for that party-connection which might lead to power, when, in the second year of the Phocian war, Chares and his partizans, after peace had been made with the revolted allies of Athens, wanting a field for military adventure, absurdly thought of leading the republic into a war with Persia. Then at the age of nine-and-twenty he delivered the first of his speeches, that seems to have attracted public attention enough to induce its publication; and he spoke in opposition. The orators of the war-party, who had spoken before him, had been endeavouring, by strained panegyric of the heroic deeds of their forefathers against the Persians, to excite the many to concur in their purposes. Demosthenes, in an opening of singular art, elegance, and conciseness, admitting the deeds of their forefathers to have been above all praise, turned their panegyric and argument successfully into ridicule. The Persian court really had no designs, at that time, of proceeding to actual war with Greece. The union of the Greeks was a chimerical idea, as he justly represents, and their partial attack could only expose their weakness. At the same time, he exhorted to preparation against the eventual hostilities of either Persia or of any other foe. In conclusion, he says, "Do not, then, discover to the world the melancholy state of Greece, by inviting those to an alliance whom you cannot gain, and engaging in a war which you cannot support: *Be quiet; be resolute; be prepared.* Let not the emissaries of Persia report to their king, that Greece and Athens are distracted in their councils, are confounded by their fears, are torn by dissensions. No! let them rather tell him, that if it were not equally shameful for the Greeks to violate their honour and their oaths, as it is to him matter of triumph, they would have long since marched against him; and that, if you do not march, you are restrained solely by a regard to your own dignity: That it is your prayer to all the gods, that he may be seized with the infatuation which once possessed his ancestors, and then he would find no defect of vigour in your measures. * * * * * You should prepare your force against your present enemies; you should use this force against the king, (so the king of Persia was always designated,) against any power that may attempt to injure you. But never be the first to break through the bounds of justice, either in council or in action; you should be solicitous, not that our speeches, but our conduct, should be worthy of our illustrious descent. Act thus, and you will serve not yourselves only, but the men who oppose these measures; for they will not feel your resentment hereafter, if they be not suffered to mislead you now." This speech was applauded; and although he was the first, and almost the only one, to oppose the Persian war, his advice was followed.—His next oration was on the subject of the regulation of the state: The war-party having engaged in projects of complex hostility, began to feel their finances fail, and ventured upon the bold attempt of persuading the people to surrender, for the purposes of war, some of those gratifications, which, under the sanction of severe laws, consumed almost the whole of the public revenue. Demosthenes spoke again in opposition, and appeared as the public antagonist of Chares. He resisted the proposed abolition of the distributions from the treasury, and argued, that if war was to be made, the citizens themselves should serve, as in good times of old. The money which the war-party thus proposed to raise, he observed, (probably with great truth,) was to raise a mercenary force for their generals to command, more for their private interest than for any public good. In this oration, his severe allusions to the oppressions which his countrymen exercised over their allies, leave a prepossession in the mind in favour of the spirit which dictated the part which he took.—His next oration was for the Megalopolitans. In order to understand the subject of this oration, it is necessary to turn back to the period when the genius of Epaminondas had put an end to the tyranny of Sparta. The Arcadians and Argives having risen at that period against Lacedemon, the Lacedemonians solicited aid from Athens, who, forgetting her rivalship with Sparta, and fearing Thebes, sent armies to the assistance of the former. It is not to the present purpose to mention the several events in the course of this war; it is only necessary to observe, that the Arcadians, in order the better to secure that liberty for which they contended, determined to collect all their force into one body, brought the detached settlements of their countrymen to an union, and fixed their common residence in a city called Megalopolis, or the great city. The question at Athens was, Whether this rallying point for a people once subdued by the Spartans, should be sanctioned, or not, by their permission? On the one hand was pleaded the common cause of Sparta and Athens; an union of interest which seemed to forbid that any check should be put upon Lacedemon, and the settlement of Megalopolis was considered as likely to be such a check. On the other hand, Demosthenes (it must be owned, without pleading upon the broad principles of justice,) argues for the Megalopolitans, as likely to be allies of more consequence to Athens than Sparta itself; and even contends, that their establishment was necessary to balance the power of Thebes and Sparta. In conclusion, he conjures his countrymen not to abandon the people of Megalopolis, nor any weaker state, to the power of the stronger. The result of the contest is not reported;

but it remains among ancient writers to be gathered, that though the Athenian people were not prevailed upon directly and openly to oppose their allies the Lacedemonians, yet the associates of Isocrates could procure no concurrence in the arrangement proposed by Lacedemon. Demosthenes was now embarked in the highly democratical side of Chares.

The event of the social war has been already noticed. For three years the states of Chios, Cos, and Rhodes, had confederated in resisting the dominion of Athens; and in their fears of the Persian arms, the Athenians had been forced to give a peace, by which it was stipulated that the confederates should be free and independent, or at least that they should pay no other tribute to Athens than such as their respestive representatives residing at Athens should consent to. Rhodes, after this peace, became a prey to infuriate factions. The aristocracy unable to withstand the democratical party, applied to Artemisia, princess of Caria, who held a kind of feudal principality under the Persian empire, and received a Carian garrison into their citadel. The Rhodian democracy applied for aid to the Athenians; and in the assembly convened on this occasion, Demosthenes pleaded their cause. Their cause laboured under difficulties. In the late resistance of Rhodes, the many had been distinguished for their zeal, or for what the imperial republic of Athens chose to denominate, their insolence and ingratitude towards the Athenians. It was well known besides, that the Persian king interested himself on the side of the Carian aristocrats. The clients of Demosthenes, the Rhodian democracy, were the recent and most formidable champions of an independence fought for, and won in despite of Athens; and in speaking of Persia, the orator was obliged to modify or obliterate, as well as he could, the impressions of his former arguments in favour of pacific policy towards the great king. Fearing directly to meet the prejudices of his audience against the Rhodians, Demosthenes took the broad and popular ground of arguing, that it was not the cause of the Rhodes that he was pleading, but the common cause of democracy. Such was the universal connection of the democratical cause; so readily, if variance arose between democratical governments, they fell into concord again, that it would be better for Athens, (he contended,) to be at war with all the states of Greece together, if all were under democratical government, than to have peace and alliance with all under oligarchy. What decree followed we are not informed, but no measures, or none that were effectual, were taken to support the Rhodian petitioners, perhaps because the attention of the Athenian government was forcibly called another way. While the states of Greece were weakening themselves in the sacred war, Philip was extending his frontier without interruption, by taking in such places as were either convenient or troublesome to him. It was not long before he had an opportunity of engaging as a party in the Phocian war. The nobility of Thessaly were scarcely delivered from the yoke of Alexander of Pheræ, when another intolerable tyranny succeeded under Tysophanus, Lycophron, and Pertholaus. These, with the Aleuadæ, the descendants of Hercules at their head, petitioned for Philip's assistance against their oppressors. He marched into Thessaly, and soon divested the tyrants of all authority. After this, he marched against the Phocians, who had supported the cause of the tyrant, and having obtained the most decisive success, advanced as far as the pass of Thermopylæ, with the combined Macedonian and Thessalian forces. His approach naturally alarmed the Athenians, and they met him with a force, before which he thought proper to retire. Previous to this, negociations for peace had been attempted, between Macedonia and Olynthus as confederates on one side, and the Athenians on the other; but they ended in nothing. Within a few years, Philip's conquest of Thrace, his acquisition of the gold mines in that region, his successful interference in Thessaly, the whole progress of his affairs, and the spreading popularity of his name throughout Greece, made him an object of terrific importance to the only Grecian states which retained the semblance of a power to oppose him. At this distance of time, the best informed can only conjecture what would have been the fate of Athens if she had given a fair trial to the repeated declarations of Philip, that he wished not for destruction, and was unwilling to come to extremities with her. The ruling party of Athens, were not disposed to hazard any thing like such an experiment. A triumph which Phocion obtained with the Athenian arms in Eubœa, seemed to promise the entire revival of the milder and more moderate party; but they seem to have never gained it completely. About the end of the second, or the beginning of the third year of the 107th Olympiad, commenced those famous speeches against Philip, from the celebrity of which, their name was adopted by Rome, and afterwards by modern Europe, to designate orations abounding with hostility. The first of these seems not, however, to have produced a decided effect on the actions of the Athenians. They retained their ambition, but not their primitive energy; and Philip, independent of most all men, who dreaded the extreme violence of the war-party, had also his venal partizans, who were favourably heard. The defection of Olynthus, however, from the side of Philip to that of Athens, gave a new turn to affairs. The Olynthians pressed the Athenians for immediate succours. Their ambassador opened their commission in an assembly of the people. As the importance of the occasion increased the number of the speakers, the elder orators had debated the affair before Demosthenes arose. In his first Olynthic oration, therefore, he speaks as to a people already informed, urges the necessity of joining with the Olynthians, inveighs against the designs and ambition of Philip, and labours to remove their dreadful apprehensions of his power, and to put an end to all domestic dissensions. In consequence of the first Olynthic oration, the assembly decreed that relief should be sent to the Olynthians, and thirty galleys, and two thousand men, were accordingly dispatched under the command of Chares. But these succours, consisting entirely of mercenaries, and commanded by a general of no great reputation, could not be of decisive service, and were besides suspected, and scarcely less dreaded by the Olynthians than the Macedonians themselves. In the mean time, the progress of Philip's arms could meet with little opposition, and having twice defeated the Olynthians, he shut them up in their city. In this emergency, they applied for fresh succours from Athens; and the object of our orator's second Olynthic oration, was to prove, that both the honour and interest of Athens demanded compliance. Inefficient succours having been sent, a third Olynthic oration was devoted to the same object as before. Olynthus fell into the hands of Philip, and the Athenians, (Demosthenes himself advising the measure,) thought it necessary to come to negociations for peace. Two several embassies were dispatched from Athens to Macedon, and Demosthenes accompanied both. If we may trust the account of the bitterest enemy, he behaved with ridiculous affectation at the court of Philip. In an unusual situation, to which his temper and habits were adverse, his extensive genius failed him, and the aukwardness of his apologies to Philip, and the absurdity of some of his compliments, are said to have moved the laughter of the by-standers. All this, however, is told on the authority of his oratorial rival.

Peace was established. The Athenian ambassadors, who concluded the treaty, gave, on their return, a favourable account of the appearance of candour and sincerity in Philip; but a violent sensation was produced in the popular mind, by the intelligence that the Phocians, by the influence of Philip, had been deprived of their seat in the Amphyctionic council, and that the double voice which they had enjoyed in it, should be transferred to the King of Macedon. The Athenians had not been present at Philip's election into this council; he thought proper, however, to send them an invitation to come and ratify his election. The proposal raised a violent ferment in the assembly. On this occasion, Demosthenes delivered his oration on the peace. His object is expressly declared by himself to be, to inculcate, that whether subsidies, or alliances, or whatever schemes were concerting for the public good, one point should be secured, the continuance of the present peace. These are his words; but his covert object is evidently, rather to dissuade them from making the election of Philip into the Amphyctions (an object which he calls a mere shadow) the ground of war, than to dissuade them from war altogether. He urges the impolicy of affording Philip such a pretence for war, as would rally round his standard a number of states, who, if the war were declared for a different and more rational object, would either be neutral, or attach themselves to Athens. Two years after this oration on the peace, Demosthenes delivered his seventh against Philip, or as it is commonly called, his second Philippic. The peace of Athens and Macedon had been quickly followed by the most violent political agitations in Peloponnesus. The Thebans, retaining their ancient enmity to Lacedemon, supported the pretensions of Messene and Argos to shake off the Lacedemonian yoke; and certainly with a colour of justice, since the former power had no right over the latter, but the right of the strongest. The Thebans also besought the king of Macedon to assist them in reducing the power of Lacedemon; and he listened to their overture. In this convulsed state of the Peloponnesus, a congress of delegates was held from all, or many of the governments; and Demosthenes had attended this congress, with a view to persuade the Messenians and Argians to throw themselves into Athenian, instead of Macedonian patronage. His eloquence was applauded, but his arguments seem to have failed of effect. The same subject gave again occasion to what is called his second, or otherwise his seventh Philippic, pronounced before the Athenian people. The Lacedemonians had applied to Athens for succour. On the other hand, Thebes, Argos, and Messene, sent representatives to plead for themselves, and to reproach Athens for favouring Lacedemon, the tyrant of the Peloponnesus. Demosthenes, in advising what answer should be given to the Lacedemonian ambassadors, pronounced the whole business to betray the designs of Philip against the best liberties of Greece; and concluded by an accusation of Æschines for having advised, in the recent ratification of peace, the surrender of Phocis and Thermopylæ. The vehemence of Demosthenes determined the Athenians to oppose the attempts of Philip in the Peloponnesus, and his influence with the Argians and Messenians, at length detached those states from the Macedonian alliance. The subject of discord was soon changed from Peloponnesus to the Thracian Chersonese. In the course of the late war, the states of this peninsula had shaken off their dependence on Athens, and bowed to the stronger influence of Macedon.

But while Philip was called off during his truce with Athens, to more remote conquests among the snowy deserts of Eastern Thrace, it seemed a favourable occasion for the war-party of Athens to fix a settlement on the Thracian Chersonese, by which their maritime exactions and influence might again be restored. The conduct of the settlement was entrusted to Diopeithes, a violent character, who seems to have conducted himself entirely in the style of an ancient Buccaneer, burning, destroying, and exacting tribute among those whom Philip had a right to regard as either his allies or dependencies. Philip remonstrated to the Athenians, and many voices were raised for Diopeithes. His cause was taken up by Demosthenes, in his oration on the state of the Chersonese. Here the orator, in his boldest tone, justifies the conduct of Diopeithes, on the tyrant plea of necessity. The republic, he said, had no choice left; it was already at war with Philip, and had no alternative, but to repel force by force. Philip, he maintained, had broken articles of treaties upon record, and seized upon many of their possessions,—a seizure, for the proof of which, he appeals to their own decrees: Philip had, ever since the peace, been arming himself with all the powers of Greeks and Barbarians to destroy them, before the departure of Diopeithes and his colony. The oration had its effect, for, instead of punishing Diopeithes, the Athenians supplied him with money, in order to put him in a condition to continue his expeditions. So far, the war-party was successful; but the entire lead of administration was not yet in their hands, nor was war declared with Macedon, when Demosthenes pronounced his third Philippic, preparatory to an interference of the Athenians in the island of Eubœa; an interference, to which they were invited by Callias, the Chalcidian founder of the Eubœan general assembly. A change in Athenian politics took place at this period, in which we find Demosthenes and Phocion acting in unison, and the office of first minister of Athens filled by Demosthenes. The coalition with Phocion is explained, by the moderate and just manner in which Athens for the first time condescended to act towards a dependent state. Demosthenes not only gave his support to the liberal system adopted towards Eubœa, but, under his management, a treaty was concluded with the states of that island, granting entire independence; and a body of Athenian troops, conducted by Phocion, with little or no effort subdued all the resistance that was made to settling the peace of the island by the Theban or Macedonian troops.* For restoring liberty to the Eubœan cities, and for his various services to the republic, the thanks of the people were voted to Demosthenes, in a general assembly; and a crown of gold was decreed to be presented to him in the theatre, at the festival of Bacchus. With no less wisdom than he had shewn, on a former occasion, in resisting the plan of a needless war with Persia, the orator-minister now

* Mr Mitford doubts that there were any Macedonian troops in Eubœa, but at the same time gives historical authority for the fact of which he doubts.

cultivated connection with that power. An embassy to the Persian court, on his motion, was decreed, and, under his able direction, was successful. A considerable subsidy of money was obtained from Persia. Speculations in Thrace next engaged his attention. An inestimable object for Athens, was to gain the important town of Byzantium, (the site of modern Constantinople,) commanding the commerce of the Euxine Sea. Philip was at this time implicated in a war with Scythia; and the new connection with Persia, could not but give Athens importance in the eyes of the Byzantines, among whom the adverse parties in the interests of Macedon and Athens were still doubtfully balanced. The object of gaining Byzantium appeared so important to Demosthenes, as to induce him to leave the Athenian people, for a time, to the impression of the eloquence of others, while he undertook himself an embassy to Thrace. In proposing his new system of liberal alliance, he seems to have had the concurrence of the party of Phocion. His success evidently was great. In Perynthus, Selymbria, and Byzantium, a preponderance was given to the Athenian party, and between alliance with Athens, and war with Macedonia, the transition was short. Philip returning from his Scythian campaign, immediately began the reduction of the Thracian cities which had abjured his authority, and among these to Perynthus. The fall of this place was delayed by the interposition of Persia, who, alarmed at the progress of Philip's arms, sent directions to the governors of the maritime places, to supply the besieged city with every kind of assistance; while the Byzantines sent into the city the flower of their youth, with all the necessaries for an obstinate defence. The Perynthians then reinforced, were, however, still dependent on the succours of Athens, in whose cause and alliance they considered themselves as suffering. On this occasion, Demosthenes delivered his fourth Philippic, which, in point of argument, is a concentrated repetition of all that could be urged for a war with Philip, but which is animated with an increased confidence in the power of his party, and in the revival of his own favour with a majority of the people.

It is impossible to deny Demosthenes the praise of vigour and activity, in bringing affairs to this crisis; but his connexion with the high democratical party, while it served his purpose of guiding the popular will to decisive hostilities, unhappily involved him in a fatal error with regard to military events. The expedition to relieve the Thracian cities, was consigned to Chares, who, without reputation to insure the confidence of his allies, or conduct to deserve it, wandered along the coasts, extorting contributions, and feared by all his enemies, till he was defeated by the admiral of Philip, and lost the greater part of his fleet. In the mean time, before war was formally declared on either side, Philip addressed a remonstrance to the Athenians, in the shape of a letter, which is still preserved, and is one of the most valuable state papers of antiquity, singularly combining dignity with simplicity, perspicuity with conciseness, civility and moderation of expression with force of argument. On the subject of this letter, Demosthenes delivered another oration, in which he avoids, with singular art, to enter on the facts of Philip's exposition,—affects to consider the letter as an open declaration of war,—inflames the imaginations of his hearers with this idea, and speaks only of the means to support their arms against so powerful an enemy.

When Philip had assembled an army for the invasion of Attica, Demosthenes put himself at the head of an embassy to persuade the Bœotians to take part against him, and by the force of his eloquence, he succeeded, notwithstanding the efforts of Python, an orator of great fame, who was Philip's advocate on the occasion. His triumph, however, met with a severe check, from Philip's subsequent victory over the combined forces at Cheronea, where the orator betrayed a great want of personal courage. It may be but fair charity to the memory of Demosthenes to recollect a similar instance of cowardice in a hero, who afterwards filled the world with his military fame. The great Frederick of Prussia is known to have fled in the first engagement which he ever fought. His opponents at Athens brought Demosthenes to trial for this behaviour; but the people acquitted him, and he was appointed to pronounce the funeral harangue of those who fell at Cheronea.

The death of Philip opened to Athens a false hope of returning power and security; and Demosthenes appeared on the occasion with a garland on his head, though he had but a few days before lost his daughter. A new league was formed, chiefly by his influence, among the states of Greece; but the terrible chastisement which Alexander inflicted on Thebes, broke the courage of the confederacy; and the Athenians found it necessary to send an embassy to the conqueror, in which Demosthenes at first proposed to take a share, but his apprehensions caused him to turn back upon the road. Alexander required him to be delivered up among the other orators; but Demades pacified the king without this sacrifice. Demosthenes having displayed his patriotism by rebuilding the walls of Athens at his own expence, was recompensed by a crown of gold, which was decreed to him. On the decline of his influence, Æschines brought an accusation against him on this subject, which occasioned a solemn trial, and the delivering of his celebrated oration on the crown. Some time after this triumph, occurred the most discreditable anecdote, if it can be believed, which the life of this great man presents. Harpalus, a discarded favourite of Alexander, had fled with his treasures to Athens, where he bribed the orators, and laboured to gain the protection of the state. Demosthenes, at first, urged his countrymen to avoid the danger of entertaining such a guest, and instigated an inquiry into Harpalus's treasures. In looking over them, however, the sight of a golden cup of exquisite workmanship, is said to have struck his cupidity, which he privately accepted from Harpalus, and appeared next day in the assembly with his throat wrapt in wool, as if he had a quinsy, to excuse himself from speaking. Some jests were passed, but more serious consequences ensued; for, on Demosthenes insisting on the matter being brought to a trial, he was found guilty by the Areopagus, and sentenced to a fine of fifty talents. It should be mentioned in behalf of Demosthenes, that Pausanias vindicates his innocence, and mentions, as a proof of it, that an authentic account was sent to Athens after the death of Harpalus, of all the sums distributed by him in this city, and of the persons to whom each sum was paid, and that no mention was at all made of Demosthenes; though Philoxenus, who procured the account, as well as Alexander who received it, were both the personal enemies of Demosthenes. Amidst the corruption and degeneracy of Athens, the sentence of the Areopagus itself ceases to be a decisive proof of guilt, since Dinarchus, the accuser of Demosthenes on this occasion, speaks expressly of a case in which one of its judges had been corrupted. Unable to pay this fine, he was imprisoned, but escaped from confinement, and passed some time in a melancholy exile on the island of Ægina. On the death of Alexander, when a new confederacy was planned by the Grecian states, Demosthenes ventured to leave the island, and, attending the Athenian deputies from city to city, made such efforts for the common cause, that his countrymen thought fit to recal him. A public galley was sent to bring him home; and on the road from the Piræus to Athens, he was met, and welcomed in triumph, by the whole body of citizens. As his fine could not be legally remitted, an equal sum was set aside to relieve him, on pretext of paying his charges, as conductor of the sacrifices to Jupiter the Preserver. But the victory of Antipater over the confederated Greeks at Cranon, in Thessaly, dispelled all the hopes of their cause, and Athens was obliged to purchase peace by the sacrifice of her ten public speakers, among whom Demosthenes was included. On the motion of Demades, a decree passed, condemning them to death. Demosthenes fled to the island of Calauria, and there took shelter in the temple of Neptune. But he was pursued thither by Archias, one of the instruments of Antipater's vengeance, attended by a party of soldiers. Archias, who had been formerly a tragedian, affected to look on his victim with commiseration, and gave him hopes of pardon and safety. Demosthenes coldly and contemptuously replied, "Your acting never affected me, nor can your promises make the least impression." When Archias began to speak in more peremptory terms, "Now," said Demosthenes, "you pronounce the very dictates of the Macedonian oracle, before you had but acted a part. I desire but a moment's respite, that I may send some directions to my family." He then retired, and seemed employed in writing; but when Archias and the soldiers returned, they found him with his head bowed down and covered. Imputing his behaviour to fear, they desired him to rise; but he had swallowed poison, and feeling its deadly effects coming on, he uncovered his head, and fixing his eyes on Archias, "Now," said he, "you need not scruple to act the part of Creon in the tragedy, and to cast out this corpse unburned;" (alluding to a speech in the Antigone of Sophocles, in which Creon orders, that the body of Polynices should be exposed to dogs and birds of prey.) "Oh! gracious Neptune," he then exclaimed, "I will not defile thy temple; while I yet live, I retire from this holy place, which Antipater and the Macedonians have not left unpolluted." He then rose, and desired to be supported, but as he passed the altar, sunk down and expired with a groan.—He died at the age of sixty, and his fickle countrymen regretting his fate, among other honours paid to his memory, erected a statue to him with an inscription, importing, that if his arm could have seconded his counsels, Greece would not have bowed down to Macedon.

The oratorial character of Demosthenes is one of the few points of taste in which the affectation of singularity, or the love of paradox, has hardly ventured to establish a dissentient opinion. The occasional preference of Cicero is established on a predilection for excellence of a different kind, not of a higher degree. The orations of the Roman orator, it seems to be generally agreed, form a larger and more luxuriant treat to the reader; but for giving an idea of consummate pleading, those of Demosthenes are preferred. His style is acknowledged to have a kind of magic, peculiar to himself, even in the Greek language, and which is not to be transfused into translation; in the matter, even when he may be suspected of labouring in the weaker cause, there is a neatness of delusive reasoning, a subtlety of insinuation avoiding assertion, but calculated to infuse belief without pledging the speaker; even his silence, it has been remarked, is frequently pregnant with meaning. That characteristic of eloquence, which Quintilian (from the Greek) calls δεινωσις, is not perhaps to be translated by the single term aggravation—it is in him the power of arraying truth in majestic terror—of alarming and electrifying the attending mind. Even at this day, a reader who, in cooler moments, may well question the general policy of his system towards Macedon, opens one of his Philippics with tacit reflections on the insolence and tyranny of Athens, and the magnanimity of Philip, but as he proceeds, feels his sympathy carried on, to participate in the passions of jealousy, disdain, and impatience for action, which he infuses into the breasts of his audience. The opinions of Cicero and Quintilian on the supremacy of his powers, are in themselves splendid passages of eloquence, which have been often cited. It may be added, that eloquence by no means comprises the sum of his character; Lord Bolingbroke justly remarks, in speculating on the part which he acted in history, that "haranguing was at this time the least part of the business of Demosthenes; and eloquence, neither the sole nor the principal talent, as the style of writers would induce us to believe, on which his success depended. He must have been master of other arts, subservient to which his eloquence was employed; and must have had a thorough knowledge of his own state, and of the other states of Greece, of their dispositions and of their interests relatively to one another, and relatively to their neighbours—to the Persians particularly, with whom he had correspondence not much to his honour,—I say he must have been master of many other arts, and have possessed an immense fund of knowledge, to make his eloquence in every case successful, and even pertinent and seasonable in some, as well as to direct it and furnish it with matter whenever he thought fit to employ that weapon." (*n*)

DENBIGHSHIRE, is an inland county of North Wales. It runs parallel to Flintshire, but it is much more extensive. Although we have denominated it an inland county, yet in one point it just touches on the Irish Sea. On the north-east, it is bounded by Flintshire and Cheshire; on the south-east by Shropshire; on the north-west by Montgomery, Merioneth, and Caernarvon. From Merioneth it is separated by the Bereryn Mountains; and from Caernarvon by the river Conway. The promontory of the Great Ormes-head; however, which is on the eastern side of this river, is in Caernarvonshire. Denbighshire, from Llandwst, on the Conway, to Holt, on the river Dee, measures 36 miles; and from St Asaph to Ysbytty Eran, 19 miles: in its narrowest breadth over the vale of Clwyd, it is but nine miles. The climate of this county, like that of the other parts of North Wales, is of three kinds: that of the vales, the hills, and the mountains. Frequently when it rains in the vallies, sleet falls on the hills, and snow on the mountains. In some parts of the mountainous district of Denbighshire, oats are frequently seen in the month of October quite green. The time of harvest in the vallies is August; on the hills, September, or the beginning of October. The most constant winds are from the east, prevailing during the frosts in winter and the backward cold springs. But the wind blows much more frequently from the west or south-west, though not with such steadiness and constancy. These winds have been observed to prevail nearly three-fourths

Denbighshire.

of the whole year. The quantity of rain that falls on an average, at Llanrwst, is computed to be about fifty inches. Strong loam prevails in the vale of Clwyd, below Ruthin, and in some other parts of the county; but it is by no means common. Above Ruthin, the soil of the vale of Clwyd is a lighter loam, which is also found in the valley of Llanrwst, and in most of the other vale lands. A still lighter species of soil prevails on the slopes of the hills, especially where they have a southern aspect, and have a substratum of limestone. Where the substratum is slate, the soil is *till*, cold, and unproductive. Immense quantities of peat, or moss, are found in the mountainous districts. The principal rivers in Denbighshire, are the Clwyd, Elwy, Dee, and Conway. The tenure of estates is of a mixed kind, between feudal and allodial; they being held either mediately or immediately *in capite* of the king. The size of farms varies much. Scarcely any reach 600 acres; and in general they do not exceed 200, except in the mountain farms, which run to 1000 acres or upwards. The rent, in the vales, is from 20s. to 30s. per acre; in the smaller dales, and on the hilly parts, from 15s. to 20s. The sheep-farms are seldom let by the acre, but they may be reckoned at from 1s. 6d. to 2s. per acre. In the south-east extremity of the county, on the banks of the Dee, there is rich pasture and meadow land, and cheese is made nearly equal to that of Cheshire. In the northern part of the county, many cattle are reared and fed. The vales are chiefly devoted to the growth of corn.

The most celebrated vales in Denbighshire, are those of Clwyd, Llangollen, and Valle Crucis. The first is perhaps the most extensive of any of the kingdom, being 24 miles in length, and about seven in width. It is in a high state of cultivation, and is, moreover, naturally very fertile. Twenty returns of excellent wheat have been produced in it. The river Clwyd runs through it. It is, however, much inferior in picturesque beauty to the vale of Llangollen, and some other vales in this county, though it assumes this character, in some degree, as it contracts beyond this shire, where it is bounded on the Flintshire side by lofty limestone hills, and on the south by the slate rocks of Merioneth, the sides of which are covered with extensive woods. The vale of Llangollen has been much celebrated from the steep banks on the south side of the Dee; by the Oswestry road to Llangollen, the vale is seen to great advantage, the river, winding in elegant courses along the wooded meadows beneath; and the prospect of it from its mouth also, where it sinks into the plain of Salop, towards its commencement, is uncommonly striking; yet some of its most beautiful scenes are greatly disfigured by a formal range of limestone rocks on the north-west side of it. The vale of Crucis extends nearly to Llangollen; it is represented as one of the most charmingly secluded vales that the kingdom can boast of, surrounded by high mountains, the sides and bottoms of which are clad with wood and verdure. The venerable ruins of Valley Crucis Abbey, embowered in trees, add very much to the picturesque effect of this vale. It may be remarked, that the woods near Erthig, in this county, is the only spot in North Wales where the nightingale is heard. There is not much timber in Denbighshire; the best wooded estate is probably that of Lord Bagot's, in the vale of Clwyd.

There are two ranges of mountains in Denbighshire, the Berwyn and the Clwydian range; the former takes its rise near Chirk Castle; its geometrical length is 54 miles, in a straight line 49 miles; its greatest elevation rather more than 3000 feet; it is principally argillaceous, with some chert. Immense quantities of slate are procured from this range. Oernaut, near Llangollen, is considered as the north-eastern commencement of the Berwyn line of slate quarries. A branch of the Ellesmere canal extends from the Pontcysylte aqueduct nearly to this quarry. The slates are more durable than those procured from the quarries near Chirk. The Clwydian range consists of two branches, only one of which properly belongs to Denbighshire; it is from 25 to 30 miles in length, and from 5 to 9 miles broad; it consists principally of shale, semi-indurated whin, and flags for flooring and tomb-stones. This branch is covered with heath or ling; and the hollows abound with peat, so hard and close grained that it exhibits a polished surface when dry. The vale of Clywd lies between the two branches of this range.

Besides slate, lime, coal, and a little lead ore found in Denbighshire, limestone is found at the upper end of the vale of Clwyd; and it composes the Eglwyseg rocks in Llangollen vale. Another branch of this range of limestone hills turns to the north-west, and crossing the collieries and freestone quarries at Ruabon, appears at Minera, near Wrexham. Dark-coloured argillaceous limestone may also be traced from Denbighshire in a south-western direction across Merionethshire; it is much inferior to the white limestone, both as a cement and manure. The lead mines of this county lie on the borders of Flintshire. Near Wrexham, the Minera lead works, which had been wrought for ages, and were considered as nearly exhausted, have been resumed, a fresh vein, five feet broad, having been discovered at the depth of 70 yards. Coal is found above limestone in the eastern part of the county, and very extensive beds between limestone and the sand rocks about Wrexham. At Plas Kynaston, that species of coal, called *cannel*, is found. Granite porphyry in mass, micaceous schistus, and other primitive stratified rocks, as well as serpentine, and hornblende slate mixed with veins and rocks of quartz, are found near Llanrwst.

The principal manufacture of Denbighshire is what is termed *small cloths*; they are thus denominated to distinguish them from the *strong* cloth, which is made near Dolgellen; the pieces of both are of the same length, but the small cloth is about one eight of a yard narrower. It is entirely manufactured within the parish of Glynn, a large tract of country lying between Llangollen and Corwen: in this district there are eleven fulling mills, which dress about 22 webs per week, each web containing about 190 yards. The amount of the annual manufacture is supposed to be L.12,679; the prime cost of the materials L.8475, and the wages of labour L.4204. It is chiefly used for dyeing. The market for Glynn webs is held every Wednesday at Oswestry. Knit stockings and socks are made near Llanrwst. In the neighbourhood of Wrexham there are several manufactories of military instruments; and a large cannon foundry not far from the town. The greatest fair in North Wales is held at this place, commencing on the 23d of March, and continuing to the end of the following week. At Llanrwst there is a great market for stockings.

The Ellesmere canal enters the county of Denbigh at Pulsford, and a branch turns off to the Ffrwd colliery. This canal, which was laid out by Mr Telford, passes over two of the finest aqueduct bridges in the kingdom, viz. those of Chirk and Pontcysylte. The last of these carries the canal over the river Dee, at the bottom of Llangollen vale, and is perhaps the most elegant and splendid structure of the kind in Europe. The piers are of stone, and all the rest of cast iron. The height of the centre piers is about 150 feet, and the number of arches about 13. The Ruabon collieries are connected with it by means of iron rail-roads. On the north side of the Dee, a branch extends to Llangollen; and, as has been already noticed, to the vicinity of the Oernaut slate quarries. The river Conway is navigable for small craft to within two miles of Llanrwst. Near this place is a bridge built by Inigo Jones, consisting of three arches, the middle one of which is nearly 60 feet wide.

There are 57 parishes in Denbighshire, and 6 market towns. The number of acres, by recent survey, is found to be 387,600. It returns two members to parliament. Is partly in the diocese of St Asaph and partly in that of Bangor, and in the province of Canterbury. It pays one part to the land-tax.

The following is an abstract of the population return for 1811:

Inhabited houses	13,078
Families that occupy them	13,703
Uninhabited houses	281
Families employed in agriculture	7,973
Ditto in trade and manufactures	2,283
Males	31,129
Females	33,111
Total population	64,240

The town of Denbigh is pleasantly situated on a limestone eminence, which commands an extensive view of the most beautiful part of the vale of Clwyd. On the summit of this eminence are the fine ruins of its castle. All the streets, except one, are very irregular, and the houses, for the most part, are ill-built. It is governed by two aldermen, a recorder, two bailiffs, and twenty-five capital burgesses. Along with Ruthin and Holt, it sends one member to parliament. It is principally inhabited by tanners, glovers, and shoemakers; and sends a considerable quantity of gloves and shoes to London for exportation. About 50 years ago, a broad cloth manufactory was established here, but it did not succeed. Between this place and Ruthin, nearly 13 acres of lavender are generally grown, which is distilled and sent to London. The population of the town of Denbigh in 1811, was 2714. See Bingley's *North Wales*; Aikin's *Tour through North Wales*; Davies' *View of the Agriculture of North Wales*; and the article INLAND NAVIGATION, for drawings and descriptions of the aqueduct bridges of Chirk and Pontcysylte. (W. S.)

DENDERA, or TENTYRA. See CIVIL ARCHITECTURE, vol. vi. p. 573; Plate CXLVIII.; and Plate CLII. Fig. 2. See also TENTYRA.

DENDERMOND, or TERMONDE, a town of France, in the department of the Scheldt, is situated at the junction of the rivers Scheldt and Dender, by the last of which rivers the town is traversed. The town is surrounded by marshes and fine meadows. It has two parish churches, one of which is collegiate; a college, and two convents of men and four of women. The parish church of Notre Dame contains an excellent picture of the adoration of the Shepherds by Vandyck; and in the church of the Capuchins is another of a dying Christ, which has been esteemed the *chef-d'œuvre* of the same celebrated artist.

The position of this place is very strong, as the surrounding country can readily be laid under water. Its citadel and fortifications are likewise strong; and it is considered as a place of great importance in expediting or facilitating the communication between Gand and Antwerp. The principal manufactures of Dendermond, are fustains and linen, and some imitations of Indian stuffs. The surrounding country produces corn, hemp, and flax, and is remarkable for its excellent breed of horses. The population of the town is about 5028. East Long. 4° 20′, and North Lat. 51° 3′. See Descamps *Voyage Pittoresque de Flandre*. (*j*)

DENDROBIUM, a genus of plants of the class Gynandria, and order Diandria. See BOTANY, p. 315.

DENDROMETER, from δενδρον *a tree*, and μετρον *a measure*, is a name which was at first given to a trigonometrical instrument, invented by Messrs Duncomb and Whittel, for measuring the trunk, the branches, and the height of a tree, without coming near it. This instrument, and a variety of others for the same purpose, are founded on the principle of measuring the angles which the same object, or the same part of an object, subtends at the extremities of a base actually included in the instrument. We do not conceive any of these instruments of sufficient importance as dendrometers, to deserve a separate description in this article. We shall therefore content ourselves with a few references, which will enable our readers to judge for themselves. See Duncombe and Whittel's Description of their own Dendrometer; *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, vol. 25, for an account of Mr Broad's Gauge or Measure for timber; and the *Repertory of Arts*, vol. ii. p. 238, for an account of Mr Pitts' Dendrometer. The description of a variety of new trigonometrical instruments, which may be employed as dendrometers, and for analogous purposes, will be found in Brewster's *Treatise on New Philosophical Instruments*. Edin. 1813. See MICROMETER. (*o*)

DENEKIA, a genus of plants of the class Syngenesia, and order Polygamia Superflua. See BOTANY, p. 300.

DENIS, ST. See DENYS, ST.

DENMARK.

General view.

The kingdom of Denmark is composed of several islands, as well as of part of the Continent of Europe. Of the islands, Zealand, in which the capital of the kingdom stands, is the largest. The soil is sandy, but fertile both in grain and pasturage; and the face of the country is agreeably diversified with woods and lakes. Funen or Fioni is the second in extent, but the first in fertility; it is higher ground than Zealand, from which it is separated by an arm of the sea, called the Great Belt, so named to distinguish it from the Little Belt, that divides it on the other side from Jutland. This island is particularly celebrated for the richness of its pasturage; nor are those parts of it which are arable less productive. The islands of Laland and Falster are next in point of size; the latter is abundantly productive of fruit; and both are celebrated for the excellent quality and large crops of wheat which are grown in them. The other isles require no particular notice. The head of that long peninsula, which is bounded on the west by the Ocean, on the north and east by the gulf called the Categate, and on the south by Holstein and part of the Baltic, is called Jutland, and forms the largest and most fertile of all the provinces of the kingdom of Denmark. It raises grain, not only for its own consumption, but also, in a great measure, for the support of Norway. A great number of small cattle are likewise bred in this province, which are sent into Holstein to be fattened for the markets of Amsterdam, Lubeck, and Hamburgh. To the south of Jutland lies the province of Holstein, which is bounded on the west by the Ocean and the Elbe, on the east by the Baltic sea, and on the south by part of the Electorate of Hanover. Holstein possesses a soil still more fertile than that of Jutland, and is supposed to furnish more excellent fat cattle, and provisions of all kinds, in proportion to its size, than any other province of Europe. Its climate is much more temperate and agreeable than that of any other part of the kingdom of Denmark. Norway is bounded on the north and west by Lapland and the Ocean, and on the south and east by the same Ocean and Sweden. The interior of Norway is entirely composed of mountains, covered with woods; it is cold, disagreeable, and uncultivated; on the sea coast, however, there are considerable tracts of fertile soil. To the north of Norway, Lapland is situated, inhabited by a race of people very different in figure, countenance, language, and manner of living, from the people of Norway. Such are the parts of the kingdom of Denmark, which lie contiguous to each other. Iceland, which lies between the 63d and 67th degree of north latitude, and between the 15th and 23d degree of west longitude, first inhabited by a colony of Norwegians, afterwards united to the crown of Norway, and thence passing under the power of Denmark, is a very large island, almost entirely covered with rocks, high mountains, and volcanic remains; these, united to the extreme coldness of the climate, render it a comfortless habitation for a very thin population. From Iceland a colony was sent to Greenland; but the eastern coast, on which it settled, having been since blocked up by the ice, this colony has been sought for in vain. Formerly the Norwegians possessed the islands of Orkney and Shetland; and the Danish monarch still retains the Faroe isles, seventeen in number, producing a little barley, and affording excellent pasturage for a few sheep. The small possessions which belonged to Denmark in the East and West Indies, have been captured from them by Britain, during the French revolutionary war.

Part I. HISTORY OF DENMARK.

History.

Definition.

Much doubt and conjecture have arisen respecting the etymology of the name of Denmark. Saxogrammaticus, the historian to whom we are principally indebted for our knowledge of the early history of this kingdom, is of opinion that Denmark signifies the kingdom of Dan, a monarch who is supposed to have reigned 1038 years before Christ. By others, it is alleged, that the river Eyder, which separates Denmark proper from Germany, was anciently called Dana, and that the county to which the name of Jutland is now given, was, from that river, named Danea or Denmark. Another conjecture is, that Denmark is derived from the Teutonic words *dane* or *thane*, a prince or lord, and *mark*, a boundary; hence, signifying a frontier country, under the dominion, or confided to the protection, of a thane. But the most probable conjecture is, that Denmark is derived from the *Danes*, the inhabitants, who are mentioned under this appellation in the sixth century, and *mark*, a boundary. What is the etymological meaning of *Dane*, as applied to a people, it is difficult to conjecture.

The first notice which we possess respecting the inhabitants of Denmark, is derived from the Roman historians. The ancient Cimbria seems to have comprehended Jutland, Holstein, and some parts of Lower Germany; and in some districts of Holstein, it is said that the people, even to this day, preserve the name of Cimbri. The irruption of the Cimbri and Teutones in the year of Rome 640, into the Roman territories, is well known; as well as their almost total destruction by Marius. It is, however, a curious and interesting question, whether these Cimbri were a Celtic or a Gothic people; as hence we may be enabled to determine whether, at the period of the irruption, Denmark was inhabited by the same race of people who possess it now. In support of the opinion that the Cimbri were a Celtic race, it is urged that Cimri is the name given to that division of the Celts who inhabit Wales; and that even to this day, the Welsh distinguish themselves by this appellation. This argument certainly possesses great weight; but in support of the opinion that the Cimbri were a Gothic people, it may be stated, that from history it appears they made the irruption into the Roman provinces along with the Teutones, undoubtedly a people of Gothic descent; and as the Celts and Goths differed essentially in manners, customs, dispositions, and more particularly in language, and as, moreover, the former having been subdued by the latter, and ex-

Cimbri.

History.

pelled from their habitations, cannot be supposed to have been on very friendly terms with the latter, nor to have been regarded by them with much respect, it is hardly to be supposed that they would unite in an expedition of such a magnitude and duration. It is not easy to conceive how the Cimbri, if they were a Celtic race, should have been left in possession of the Cimbric Chersonesus, at a period when we know that the Gothic tribes had poured round that country in all directions, and when the Teutones had actually settled themselves to the south and east of it. It may be further mentioned, in support of the opinion, that the Cimbri were a Gothic people, that the names of most of their leaders, as given by the Roman historians, are evidently of Gothic construction and etymology. The only objection to this hypothesis arises from the circumstance that they were called Cimbri, but this objection may be plausibly, if not satisfactorily, obviated, by supposing that the Romans gave them this name from the county which they inhabited, in the same manner as modern historians give the name of Americans to all who inhabit that quarter of the world, without meaning to imply that they are of the aboriginal race. In the time of Tacitus and Ptolemy, the Chersonese still retained the appellation Cimbri, though, from the testimony of these authors, it was entirely inhabited by Gothic tribes; according to Tacitus, those were the Angli, Varini, Eudoses, Suardones, and Nuithorus. In the island of Zealand, he places the Suiares. Ptolemy gives different appellations to these tribes, but the authority of Tacitus seems entitled to more credit.

The Cimbri were a Gothic people.

Woden or Odin.

In treating of the ancient history of Denmark, the tradition respecting Woden or Odin, must not be entirely passed over in silence. According to Snorro, an ancient historian of Norway, and Torfaces, an Icelandic writer of great erudition, Odin lived in the time of Pompey, and reigned in those districts to which Mithridates fled when defeated by the Roman general. Odin was persuaded by the defeated monarch to assist him in his distress; but being unable to resist the discipline and skill of the Romans, he was compelled to leave his own country along with his followers. How he contrived to fight his way, and to subsist during his long flight from the neighbourhood of the Black Sea till he reached the Scandinavian regions, is not known, nor even conjectured. He is said first to have reduced the island of Funen, and there to have laid the foundation of a town, which, from himself, is called Wodensee, or Odensee. From Funen he passed to Sweden, which he also subdued; and to which, after having made an equally successful expedition into Norway, he returned, when he died. Though much obscurity prevails respecting the era of Odin, and much fable is undoubtedly mixed up with the traditionary account of his origin, adventures, and conquests, yet there can be no doubt that such a person existed, and that he came from some part of Asia, and established himself in Scandinavia.

Schiold, A. C. 60.

But to return more immediately to Denmark. According to the Danish Chronicles, Schiold, the first king of this country, reigned about 60 years before Christ; and he was succeeded by eighteen kings, to the time of Ragner, surnamed Lodbrog, who began his reign A. D. 750, and who, in his attempt to invade England, was made prisoner and put to death. The Danes, at this period, were very formidable to most of the nations of the north and middle of Europe. For 200 years they spread terror on the coasts of England, and at last conquered the whole kingdom. They likewise made incursions on the coasts of Scotland, Ireland, Livonia, Courland, and Pomerania. And it is said, though on doubtful authority, that they even set fire to the palace of Charlemagne, at Aix-la-Chapelle, and carried their ravages into Spain and Italy. They were enabled to effect these conquests, and to carry on these depredations, by their expertness and skill as sailors. The greatest part of the people were from their childhood brought up to a maritime life. Their vessels were always well provided with arms, and all the men were taught to swim. A very striking proof of the attention which the government at this period paid to the establishment of a maritime force, is exhibited in the manner in which the lands were divided in Denmark and Norway. Every division took its name from the number of vessels which it was capable of equipping; and in some places these names are still in use.

Lodbrog A. D. 750.

History.

Surm, A. D. 920.

On the death of Ragner Lodbrog, who was the last of the powerful princes, under whose dominion the three kingdoms of Denmark, Norway, and Sweden were united, his sons divided these territories, and Denmark again acknowledged a separate king. Soon after this period, the more certain history of Denmark commences, with Surm, or Sormo, A. D. 920. It is not known, however, whether he was descended from a native race, or whether he was of Swedish or Norwegian origin. The confusion which, before the reign of this sovereign, is found in the Danish history, is plausibly supposed to have arisen from the circumstance, that Denmark, in fact, was never completely, or for any length of time, under the dominion of one prince; but being divided among two or three, one historian writes the history of one prince, and another of another prince; all representing their heroes as sovereigns of the whole of Denmark. Sormo united, in reality, as well as nominally, the whole of Denmark under one sovereign. He was succeeded in 945 by Harold Blaataud, his son. This prince not only made war in France and England, but attacked part of Germany, during the absence of the Emperor Otho. On his return, however, the Danes were expelled with great slaughter, and followed into Jutland, where Harold was compelled to solicit a peace, which was granted him, on condition that he and his son Swane should be baptized. In 985, Swane succeeded to the throne. From the circumstance of his having been baptized, at the command of Otho, he is sometimes called by the Danish historians, Swane-Otho. This sovereign is well known in English history, by his invasion of England.

Harold Blaataud, A. D. 945.

Swane, A. D. 985.

Canute the Great, A. D. 1017.

A new epoch in the history of Denmark commences with the reign of Canute the Great, who succeeded his father Swane, on the thrones of Denmark, England, and Norway, (See CANUTE.) The conquest of this last country had been begun by his father, and was completed by himself. The reign of this prince is principally distinguished by a code of laws, which he made for Denmark, under the title of the Laws of the Court. The chief object of those laws was the regulation of the differences which were continually arising between the officers of the army and those of the court, which were terminated by duel, a practice which Canute thought should no longer be permitted or continued in Denmark, after it had been converted to the Christian faith. Canute gave great offence to the Danes, by fixing his abode in England, and only occasionally visiting Denmark, and by filling all the places of trust in this kingdom with Englishmen. The discontent at last became so general and loud, that he thought it prudent to pass a whole winter in Denmark; while there, he employed himself in subduing part of Norway, which had revolted under

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Olaus, one of its native princes. Canute was successful in this enterprize, but afterwards returning to England, and leaving the sovereignty of Denmark to his son Hardy Canute, Magnus, the son of Olaus, not only reconquered Norway, but compelled the Danish monarch to enter into a treaty with him, which gave to the survivor the estates of the other, in case he should die without male heirs. On the death of Hardy Canute without male heirs, Magnus became King of Denmark, and England shook off the Danish yoke.

Hardy Canute.

Magnus.

Swein.

Nothing remarkable happened in the reign of Magnus, nor in that of Swein his successor. The latter reigned only two years, and was succeeded by his brother Canute the Fourth. The piety or the weakness of this prince, induced him to exempt the clergy from the civil jurisdiction of the state; to raise their rank, and increase their stipends; and at last to attempt to establish the usage of paying tithes. This, however, enraged the people, over the great body of whom he ruled with great severity; and Canute persevering in his determination, levied the tithes with such rigour, that a rebellion ensued, and he was slain as he was kneeling before the altar. Canute was succeeded in 1086 by Olaus the Second, during whose reign nothing remarkable occurred. When he died in 1095, the states elected his brother Eric the First to be king, who renewed the ancient usage of consulting the states before war was declared, or any great enterprize undertaken. After having reigned eight years, this prince died in the isle of Cyprus, while on a pilgrimage to Jerusalem. For upwards of 50 years afterwards, during the reigns of Nicholas, Eric the Second, Eric the Third, and Swein the Third, Denmark was a continual scene of confusion and bloodshed, occasioned principally by the contests between the clergy, the nobility, and the sovereigns.

Canute IV.

Olaus II. A. D. 1086.

Eric I. A. D. 1095.

Valdemar the Great, A. D. 1157.

In 1157, another epoch in the history of this kingdom commences with the reign of Valdemar the Great. He defeated the Wouds or Slavonic inhabitants of the southern shores of the Baltic; subdued the isle of Rugen, and gained possession of great part of Pomerania. According to the ancient chronicles of Pomerania, he founded the town or the castle of Dantzic, which was originally called Danskwic, or the fort of the Danes. The same chronicles relate, that Valdemar made war on a prince, whose territories lay along the banks of the Vistula, called Sobieslas. In 1169, he subdued Courland; and he was enabled, by the friendship and assistance of the Emperor Frederic Barbarossa, to retain all his conquests, except the territory on the Vistula, which, on his return to Denmark was re-occupied by Sobieslas. The reign of Valdemar is not more celebrated in Danish history for the conquests which he achieved, than for the laws that he enacted, and for the tranquillity and happiness which his wisdom and firmness established among his subjects. He revised and published two codes of laws, one called the Laws of Scania, and the other the Laws of Zealand; these related entirely to civil matters. He also drew up ecclesiastical laws for these provinces. Those laws, in conjunction with the code of Lapland, published by Valdemar the Second, are the source from which the present laws of Denmark are derived; and in their enactments they are well calculated, if properly administered, to protect the rights and property, and secure the tranquillity of the people.

Canute VI. A. D 1195.

Valdemar died in 1182, and was succeeded by his son Canute the Sixth, who, in the year 1195, caused a muster to be made of all the men fit to bear arms in his dominions; he at the same time issued orders for each province to supply its proportion of shipping, and by this means 670 vessels were equipped and manned. In his reign, part of the Duchy of Holstein, and the cities of Hamburgh and Lubeck, were annexed to the Danish territory, and he received the homage of the Duke of Pomerania and the Prince of Mecklenburg. This prince first admitted the feudal law into Denmark, which soon became the means of reducing the great bulk of the people to a state of the most abject slavery. He paid great attention to commerce, and particularly encouraged the herring fishery. A curious and interesting picture of the Danes, at this period, is given by Arnold, the author of the Slavonian Chronicle. In consequence of their commerce with the Germans, he informs us, "the Danes, who were formerly clothed as sailors, are now clothed in red, and in stuffs of other colours, and even sometimes in purple and fine linen." He describes the herring fishery as very productive and lucrative, bringing into the country, "gold, silver, and all other precious things." "Moreover, Denmark is also filled with excellent horses, which is owing to the great fertility and goodness of their pasture, so that they are distinguished in war by their cavalry and marine." According to the same authority, at this time it was usual for the nobles of Denmark to send such of their sons, as they designed for an ecclesiastical life, to Paris, to be instructed in literature and polite learning, in consequence of which, this kingdom had made a considerable progress in many of the sciences. In the reign of Canute the Sixth, several Danish historians lived, particularly Suene Aggesen, who has given an abridged history of his own country from the foundation of the government, written in correct, and rather elegant Latin.

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Valdemar II. A. D. 1202.

Canute the Sixth died in 1202, and was succeeded by his brother Valdemar the Second. His first object was to obtain from the Emperor of Germany a sanction to his claims on the countries that had been conquered from the empire during the two preceding reigns: having accomplished this, he invaded Esthonia, not so much for the sake of conquest, as in order to convert its savage and idolatrous inhabitants to the Christian faith. At first he was unsuccessful; but afterwards, the zeal and enthusiasm of his troops having been excited and directed by the clergy, who accompanied the expedition, the Esthonians submitted to him. By this conquest the Danish power extended both to the south and east shores of the Baltic. In consequence, however, of his having been surprised and carried off, while engaged in the chace, by a prince of Mecklenburgh, the conquered countries revolted; and before he regained his liberty, they had established their independence. He was defeated in 1227, by the Germans, in an attempt he made to regain Holstein; and died, stripped of most of his conquests, in 1242. This prince is much celebrated for the attention which he paid to the laws of Denmark: the code of Jutland has already been mentioned. It was drawn up in consequence of the confusion which prevailed in many parts of the kingdom: several new laws, or modifications of the old laws, had been introduced from Germany, by the doctors and advocates who had studied there, and the people were at a loss to know what was legal, and conformable to the ancient laws. To remedy this evil, Valdemar convoked a general assembly of the states at Wordingburgh in Zealand, and by this assembly the Jutland code was drawn up; this code, like our magna charta, rather gives a regular and fixed form and authority to the ancient customary and unwritten laws, than creates any new ones. In this code, particular attention

Dies, A. D. 1242.

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was paid to the maritime strength of the country, the whole of which was divided into small districts; each of these was to build and equip one ship in time of war, and furnish it with provisions as long as the king should require its service. The progress of the feudal tenure is distinctly marked by several of the enactments of this code. In the maritime districts were many free farms: but the number of these was much reduced by the permission that Valdemar gave to his favourites to purchase them, and to form them into hereditary manors: hence arose those nobles, who afterwards, in conjunction with the clergy, oppressed the people so cruelly and unmercifully, and limited and rendered insecure the power of the sovereign himself. The principal new regulations, which Valdemar introduced into the Jutland code, respected the abolition of the trial by ordeal, and the substitution of the *canonical purgation*, on the oath of one of the parties, substantiated by the oaths of eleven of his relations. The trial by jury, exactly as it is practised in England, was also established by him; but it is doubtful whether this mode of trial was followed for any length of time, and it certainly cannot now be traced in the present practice or laws of Denmark.

Eric. By the will of Valdemar, the crown of Denmark was left to his oldest son Eric, and the duchy of Sleswick to his second son Abel. The former entered into a war with the princes of Holstein, in which he solicited the assistance of his brother Abel, but Abel hired assassins,
Abel. who murdered him. After this, Abel succeeded to the crown, which, however, he did not long possess, as his subjects rebelled against him, and he was slain in battle,
A. D. 1252. in the year 1252. Although the private character of this sovereign was very bad, yet when he came to the throne, he discovered great wisdom and regard for the happiness of his subjects, in several of his regulations and laws: he re-established the custom of holding a general assembly of the states every year, which had been long neglected; and in many respects he improved upon the Jutland code.

Christopher I. Christopher the First succeeded Abel: his whole reign was a scene of confusion and civil war between him and the clergy; the disturbances continued with little or no intermission during the reign of his son, Eric the Fifth, who succeeded to the throne, when he was only ten years old, and reigned twenty-seven years.
Eric V. He compiled the code called *Birkerett* from *Birketten*, the name of the new tribunals, which were instituted by it. At this period the clergy and nobles treated the judges and governors whom the king sent into their provinces as greatly their inferiors; nor would they suffer them to exercise any jurisdiction over their lands, or even to hear or settle the complaints of their farmers, whom they considered and treated, rather as their own proper subjects than as the subjects of the king. As Eric found it would be impracticable to destroy the powers and assumed privileges of the clergy and the nobles, he endeavoured to regulate them by his new code, by which he granted to the lords of fiefs their proper jurisdiction, and laid down rules for the guidance and information of the judges in the administration of justice. But his views were frustrated; the nobility regarded more that part of the code which acknowledged and legalized their power, than that part which taught them their duty towards their vassals, and the code of birkerett, especially after the changes it underwent, in the time of Christopher of Bavaria, may be considered as having consummated and sealed the slavery of the people of Denmark. Eric the Fifth was succeeded by his son Eric the Sixth, whose reign also exhibits a continued scene of confusion and civil wars. During the short intervals of peace and tranquillity which he enjoyed, he applied himself to the formation of a code of feudal laws for Livonia, at that time a fief of the crown of Denmark; and he confirmed and extended the privileges which his predecessors had granted to the inhabitants of Lubeck and Rostock. He also directed his attention to the laws of his own country, collecting and publishing the laws of Zealand in six books; and depositing, in a place of safety, all the public acts, documents, and other papers, which might be of use in forming a complete history of Denmark.

History. Eric VI.

Christopher the Second succeeded to the throne, on the death of his brother Eric. In order to engage the states to confirm him in his power, he agreed to grant them great privileges: when he received the crown, he bound himself by an oath, to confirm and extend the privileges of the clergy; not to permit them to be accused before lay judges, on any pretext, or for any cause whatever; not to tax them; nor to arrest, banish, or deprive them of their property, except by the express order of the pope: to the nobility he promised, that he would grant them the power of condemning their vassals; and exemption from carrying arms out of the kingdom: he also bound himself to destroy all the fortresses in Jutland except three, and to grant permission for all those to return, who, in the preceding reigns, had taken up arms against their legitimate sovereigns. This extension of the powers and privileges of the clergy and nobility was resisted by the towns, which now began to feel their importance; they sent deputies to the diets; and even the peasants or farmers, who possessed small estates, now began to form a separate class. The aim and efforts of the towns and communes, were directed not only against the encroachments of the clergy and nobility, but also towards compelling the king to extend their own immunities and privileges. He was obliged to promise them, that commerce should be free, and that no tax should be laid upon it, except in cases of the greatest necessity, and then, only by the consent of the senate; that an assembly of the states should be held every year at Nybourgh; that the laws of Valdemar should be recognized as the laws of the whole kingdom; that whenever any person considered himself as unjustly dealt with by the inferior tribunals, an appeal should lie to the general assembly of the states; and that no new law should be made, but in the general assembly, and by their consent. Christopher had thus stripped himself of all real authority, and soon became sensible that he was in fact the slave of the clergy and nobility: his situation was rendered still worse by his profligacy and extravagance, so that after having mortgaged several of his provinces to his own vassals, he resolved, notwithstanding his oath, to attempt to raise taxes, without the consent of the states. He accordingly suddenly laid on a general tax on all his subjects: the nobility were to have a tenth of all their revenues, and the clergy and commons were equally charged, in proportion to their funds. The whole kingdom was immediately in a state of open and violent rebellion: the clergy expressly told him, that as he had disregarded his oaths, they should no longer consider themselves bound to obey him as their sovereign. Christopher, intimidated by this menace, and alarmed at the rebellion of his subjects, desisted from his project, but only to adopt another, equally unjust and hurtful to his real interests: he employed force to recover the lands which he had mortgaged, and refused

Christopher II.

to pay the debts which his brother or himself had contracted. This conduct irritated and inflamed the nobility, and a civil war, which continued the whole of his reign, ensued. His situation was rendered still more distressing and perilous, by the death of Eric, Duke of Sleswick, of whose son, being under age, Christopher claimed the guardianship: his claim was opposed by the Earl of Holstein, maternal uncle to the young prince: a war ensued between them, but Christopher was defeated in a battle near Gottorp. His defeat encouraged the rebellion of his subjects; who issued a solemn decree, that he, as well as his eldest son Eric, had forfeited the crown, and soon afterwards proclaimed the young Duke of Sleswick King of Denmark. This arrangement, however, was soon set aside; the new sovereign returned to his own duchy; his maternal uncle took possession of Jutland and the island of Funen; the other islands in the Baltic were divided among the discontented nobles; and Schonen, Hallund, and Blekingen, were reconquered by Sweden. The only part of the Danish dominions, which continued to recognise Christopher, was the province of Zealand, to which, after his defeat near Gottorp, he returned from Mecklenburgh, whither he had fled, and where he soon afterwards died.

Duke of Sleswick claims the crown.

On his death, the young Duke of Sleswick again claimed the crown of Denmark. His claim was at first admitted, till the assassination of his maternal uncle, who, in fact, exercised the regal power. Soon after this event, the nation, discontented and exasperated at the ascendency which the House of Holstein had gained, invited Valdemar, the youngest son of Christopher, to the throne; Eric, the oldest, having died before his father. This prince was assisted by the Emperor of Germany in the recovery of his hereditary dominions; and in a treaty of peace, which was concluded between him and the Duke of Sleswick, by which the latter renounced the crown, but kept the duchy as a hereditary fief; and, by a treaty with the king of Sweden, the provinces which had been wrested from Denmark during the reign of Christopher the Second, were restored. So far, the reign of this prince was prosperous; but the scene soon changed. The Hanse Towns, grown rich and powerful by commerce, declared war against him, and carried their ravages into the very heart of Denmark. Being assisted by some of the neighbouring powers, they compelled Valdemar to conclude a peace on their own conditions. As soon as peace was restored, he applied himself to regulate the internal state of his kingdom; but, before he had reduced his plans into practice, he died in the year 1378.

Valdemar invited to the throne.

A. D. 1378.

This prince had two daughters; the oldest was married to a Duke of Mecklenburgh, and had a son, who, on the death of his grandfather, assumed the title of king of Denmark. The second daughter, Margaret, was married to Haquin, king of Norway, and had a son, called Olaus. This son, the states of Denmark chose to be their king; and, on the death of Haquin, he also succeeded to the throne of Norway, and to the pretensions which his father had to the kingdom of Sweden. When Olaus ascended the throne of Denmark, he was only ten years of age; the states therefore declared Margaret regent during his minority; and, on his death, seven years afterwards, they chose her for their sovereign. Before, however, the states of Denmark agreed to elect Olaus, in preference to the son of the oldest daughter of Valdemar, and subsequently to fix Margaret on the throne, they took care to extend and secure their laws, liberties, and privileges. The senate of Norway followed the example of the states of Denmark, both in the election of this princess, and in fixing the terms on which they agreed to choose her as their sovereign. They also decreed, that the sceptre should pass to Eric, the nephew of Margaret, at that period an infant of five years old. Being thus securely fixed on the thrones of Denmark and Sweden, this princess, who was endowed with a most ambitious spirit, and with talents and enterprize amply sufficient to attain and secure whatever her ambition prompted her to desire, turned her thoughts towards Sweden. This kingdom was a prey to domestic convulsions. The right of succession to the crown undoubtedly belonged to her husband Haquin, as son of the last king, and to his heirs; but to the exclusion of them, Albert the Second, Duke of Mecklenburg, had been elected king. This prince, seated on a throne to which he had no title, had not policy sufficient to establish himself in it, by acts of justice, or even of clemency; on the contrary, he rendered his authority unstable by his oppression and tyranny. Margaret did not fail to take advantage of this state of things; she encouraged and extended the divisions which had taken place between him and his subjects. The clergy of Sweden were entirely in her interest, and the mass of the people were won by her generosity. She did not, however, trust to these circumstances alone; she formed a love intrigue with one of the Swedish nobility, and by this means gained many of them over to her party. Thus, supported by the clergy and a great portion of the nobility and the people, the chance of Albert in opposing her seemed desperate. He resolved, however, to attempt it: a great part of the Swedish army still adhered to him; and he received assistance from Henry of Mecklenburg, and other German princes, who were jealous and afraid of Margaret's elevation to the throne of Sweden. The Swedish malcontents, in the mean time, had put most of the fortresses into her possession, and made her a formal offer of the crown. This she accepted, on the condition that it should be made hereditary; to which condition, after some delay and hesitation, the malcontents acceded. Of all the provinces of Sweden, Margaret depended most on Dalecarlia; the inhabitants of which, warlike and intrepid, had come forth almost unanimously in her favour; and, in order to supply her with resources to carry on the contest with Albert, they put her in possession of the copper mines, notwithstanding they had been mortgaged to the princes of Holstein. Albert still had hopes, that though the malcontents had offered the crown to his rival, the Swedish senate would not go so far; he could not expect that they would support him; all he looked for, and reckoned upon, was their neutrality. In this, however, he was disappointed; perceiving that the voice of the nation was decidedly for Margaret, they ratified the treaty which she had concluded with the deputies of the malcontents, and acknowledged her queen of Sweden, Denmark, and Norway. Albert now determined to appeal to arms; and, collecting a numerous body of troops, he prepared to take the field. Nor was Margaret idle; she marched a large army, composed of Danes and Norwegians, under the command of four generals, to join the disaffected Swedes. As soon as the junction took place, they advanced against Albert, and came up with him at Falkoping, where an obstinate and furious battle was fought. Victory was for a long time doubtful; but the good fortune of Margaret at last prevailed, and the army of Albert was almost entirely cut to pieces. As

Olaus.

Margaret.

Albert II. attempts to gain the crown of Sweden.

Battle of Falkoping.

Albert taken prisoner.

soon as he saw the fate of the day, he fled from the field of battle, but was taken prisoner in the pursuit, along with his son Eric, and several of the German princes who had supported him. He was immediately confined in a strong fortress on the borders of Norway, where he remained seven years. Although this victory was great and splendid, it was not decisive. The Swedes, who still adhered to Albert, were soon joined by fresh German forces, and made themselves masters of Stockholm; while the Prince of Mecklenburg ravaged the coasts with a powerful fleet, and took possession of the Isle of Gothland. These events, however, only retarded the accomplishment of Margaret's designs and hopes. The Swedish and Pomeranian cities came over to her; and, in 1391, she ruled over the whole of the kingdom, with the exception of Stockholm, which city did not yield to her till the year 1394.

Eric elected the successor of Margaret to the crown of Sweden.

Having now completely succeeded in her favourite project of uniting the three kingdoms of the north under one head, she resolved, if possible, to procure the election of Eric of Pomerania, to be her successor to the throne of Sweden, as he had been already declared to the thrones of Denmark and Norway; for this purpose she assembled the Swedish states at Upsal, and in a long and eloquent speech, pointed out the numerous and great advantages that would result from the union of the northern kingdoms; and promised them, if they would accede to her wishes, the security of their privileges, the abolition of extraordinary taxes, and the redress of all their grievances. No opposition was made to her request, and Eric was elected her successor to the throne of Sweden.

Union of Calmar passed A. D. 1397.

In the month of June 1397, Margaret convoked the states of the three kingdoms at Calmar, where the law, called the union of Calmar, was passed. As this law was the cause of a long war between Denmark and Sweden, it will be proper to notice its principal clauses. The grand and leading proposition laid down in this law, was, that the union of the three kingdoms under one monarch, should be a fundamental and irrevocable law. In order, however, to secure to each kingdom its peculiar rights and privileges, it was expressly declared, that "the sovereign should govern the kingdom of Denmark according to the laws and customs of Denmark; and those of Sweden and Norway according to their respective laws and customs." If any person is justly banished from one of the kingdoms, he shall be equally so from the two others; and no person shall assist or defend him; but, wherever he shall be followed and cited, they shall proceed to judgment against him, according to law." "If our lord the king shall enter into any agreement or treaty with any foreign power, in which of the kingdoms soever he shall then reside, he, and the senate who are then with him, or some deputies from each kingdom, shall have the power to contract, in the name of the three kingdoms, every thing which shall be judged the most honourable and advantageous for the king and the three kingdoms." It was likewise ordained, that if any sovereign had more than one son, one only should be declared and elected king of the three kingdoms, and the others should hold fiefs; and if the king should die without any children, then the senators and the states-deputies of the three kingdoms, in concert, should elect him whom they believed before God most worthy and most capable. Such are the principal articles of the famous union of Calmar; by accomplishing which, as well as by the whole of her political conduct, Margaret has obtained from posterity the appellation of the "Semiramis of the North." This great princess died suddenly in 1412, and left Eric in peaceable possession of the three northern crowns.

Eric succeeds to the crowns of Denmark, Norway, and Sweden, A. D. 1412.

Soon after his accession to the throne, he was engaged in a war with the Count of Holstein, and with the Hanse Towns. Not being a sovereign of much talent or enterprise, he was totally unable to carry on these wars, and attend to the affairs of Sweden at the same time. The Swedes soon manifested symptoms of discontent; they justly regarded themselves as inferior, in the treatment they received from the king, to his Danish and Norwegian subjects. Their disaffection and discontent were soon evident to all but Eric, whose inattention or obstinacy were such, that he could not be persuaded to adopt such measures as would have ensured the tranquillity of Sweden. The Swedes were still farther exasperated by the taxes he levied on them, in order to prosecute his war with the Hanse Towns. In this war they conceived themselves to have no interest or concern; and therefore they thought, they should not to be taxed to support it. They had still another source of discontent: Eric had appointed Danish or German governors to nearly all the provinces and fortresses of Sweden. This of itself gave them umbrage, and was expressly contrary to the spirit of the union of Calmar. These foreign governors oppressed and tyrannized over the people; and, when complaints against them were laid before the king, he treated them with neglect or contempt. After patiently enduring their grievances for some time, the Swedes broke out into open rebellion. Eric was now seriously alarmed, and, having made peace with the Hanse Towns, he requested their intercession with his rebellious subjects; this they granted, on condition that a diet, composed of the deputies of the three Estates, should be held at Calmar. The diet was accordingly held on the 27th of July 1436, when the Swedes agreed solemnly to renew the union; the king, on his part, binding himself to respect their privileges, and not to entrust any of their strong places in future to the care of foreigners. Eric, however, was either not sincere, or he had not talents sufficient to perceive and follow his real interests; for, soon after the renewal of the union, he exercised a most tyrannical sway, not only over Sweden, but even over the Danes and Norwegians. This conduct united them all against him; and he was soon compelled by the Danes to surrender the crown. During the reign of this sovereign, the famous fortress of Elsinore was built. The principal object in erecting it was to check the commercial and maritime power of the Hanse Towns, with whom Eric was then at war. These towns soon felt the restrictions which this fortress, commanding the passage of the Sound, laid on their commerce; and, in revenge, they ravaged the coasts of Denmark and Norway. When peace, however, was concluded, they agreed to pay the tribute which Eric fixed for the passage of the Sound.

Diet of Calmar, A. D. 1436.

Eric compelled to surrender the Danish crown.

Christopher of Bavaria elected king of Denmark, and of Sweden.

The Danes, having compelled Eric to abandon the throne, elected Christopher of Bavaria, his sister's son, to be their king. After he had taken possession of the crowns of Denmark and of Norway, he directed his attention and his schemes towards Sweden. The Swedes, at first, appeared unwilling to elect him; but at last, partly by intrigues, and partly by the privileges granted or extended to them, they chose Christopher king. He was crowned at Copenhagen, which city he made the royal residence, and the capital of Denmark, instead of Roschild, which had previously enjoyed those privileges. The first object with this sovereign, after

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he was securely seated on the throne of the three kingdoms, was to revise the laws of Denmark; many of them had become obsolete, inapplicable, or insufficient; into others, many abuses had crept, either in their interpretation or administration; and the changed state and circumstances of the kingdom and of the times, required some new enactments. The plan he followed was that of Valdemar the Second; and, having directed his deliberate and impartial attention to the subject, he formed a code, distinguished for its wisdom, as well as for its leniency. In 1448, after a reign of seven years over Denmark and Norway, and six years over Sweden, during the whole of which he had proved himself a good sovereign, Christopher died.

Christopher dies, A. D. 1448.

Charles Canutson elected king of Sweden.

Immediately on this event, the Senate of Denmark invited the states of the two other kingdoms to comply with the act of union, by proceeding in concert to the election of a new king. This, however, the Swedes absolutely refused to do, electing Charles Canutson, their own countryman, and the avowed enemy of Denmark, to be their sovereign. The Danes, irritated and surprised at this conduct, assembled a diet at Roschild, and chose Christian of Oldenberg as their sovereign. According to the union of Calmar, a diet, composed of the diets of the three kingdoms, ought to have chosen the sovereign, and drawn up the articles of capitulation for him to sign; but, under the present circumstances, it was found necessary to leave the election to a small number of deputies, most of whom were senators. The Senate, from this period, arrogated to themselves the right of choosing the sovereign, and only occasionally consulted the states, out of form. The articles of capitulation which they drew up for Christian, were very numerous. The following are the most important:—The kingdom of Denmark shall continue to be free and elective: he shall not be authorised to call any foreign prince or noble into the kingdom, nor to assign him any revenue, nor to give him any lands in the kingdom, nor to admit him into the senate, without the consent of the majority of this body: The king shall not be authorised to make peace or war, nor to undertake any important enterprize, nor to give the command of any fortress, but with the consent and approbation of the senate: He shall not mortgage or alienate any lands or fortresses that depend on the crown, except necessity shall oblige him to do it; and then only with the consent of the senate: He shall conform himself to the advice of the senate, with respect to the manner in which he ought to keep his court: He shall not establish any tax without the consent of the senate. From the nature and spirit of these articles, it is abundantly evident that the senate reserved to themselves, in fact, nearly the whole power of the kingdom; indeed, no prince ever before ascended the throne of Denmark with such limited authority. In consequence of the character of Christian for moderation, and the facility with which he had agreed to secure the Danes in their rights and privileges, the Norwegians resolved to elect him their sovereign. For this purpose, the states were assembled at Opsto, and the proposals of Christian being accepted of, he was formally proclaimed king of Norway.

Christian of Oldenberg elected king of Denmark,

and king of Norway.

In the mean time, Charles Canutson, whom the Swedes had called to the throne, created such dissatisfaction among them by his capricious and tyrannical conduct, that a majority of the nation began to repent that they had broken the union of Calmar. Christian, aware of this state of things in Sweden, determined to take advantage of it; and he at length succeeded in compelling Charles Canutson to abdicate the throne, and was himself proclaimed and crowned king at Upsal: thus the three northern kingdoms were again united under one sovereign, agreeably to the union of Calmar. Almost immediately after Christian was chosen king of Sweden, the duke of Sleswick died; this duchy and the country of Holstein had long been held as fiefs of the crown of Denmark; and as the duke died without leaving any heirs, Christian, not only in his character as king of Denmark, but also as near relation of the deceased, had just pretensions to those territories. As Christian, however, before he ascended the throne of Denmark, had bound himself to the late duke, never to unite Sleswick and Holstein to the crown of Denmark, he could not directly and openly put in his claims to them; he adopted more cautious measures: Having assembled the states of these countries, he laid before them his claims, on which, however, he declared he did not mean to insist; but if they chose to elect him, he was willing to secure their privileges to the fullest extent, and in the most solemn and positive manner: he thus succeeded in his object, solemnly declaring in the articles that he signed, that he was elected duke of Sleswick and count of Holstein, *not* as king of Denmark, but by the free will of the states. As soon as he was firmly fixed in the possession of these provinces, he summoned the inhabitants of Hamburgh to pay the homage due to him as count of Holstein; and on their complying with this summons, he confirmed all their privileges.

Canutson abdicates the Swedish throne, and Christian of Denmark elected king.

But Sweden could not remain long quiet and contented; the clergy and the nobles, in particular, were dissatisfied: a rebellion broke out, and the archbishop of Upsal threw off his robes and put himself at the head of a large army. Christian, in this embarrassing predicament, was as much indebted to his character for moderation and good intentions as to his arms; and at last he succeeded in bringing over the archbishop and most of the clergy to his interests. As, however, the nobility still held out against him, and filled the kingdom with dissensions and turbulence, Christian, in a great measure, withdrew his attempts to subdue them, and employed his entire attention in the improvement of his other dominions. A favourite object with him was the establishment of a university at Copenhagen; before that, all the nobility and people of consequence in Denmark were accustomed to send their sons, at a great expence, to be educated at Cologne or Paris; in prosecuting his scheme, however, he met with opposition from a quarter from which he did not anticipate it. The clergy were either indifferent or averse to the establishment of the proposed university; difficulties and delays consequently occurred, and before Christian could complete this and other plans for the benefit and improvement of his kingdom, he died in the year 1481, and in the 55th year of his age. Almost all the contemporary historians concur in representing him as a prince of great moderation, humanity, and liberality; he never permitted his resentment or passion to hurry him beyond the bounds of justice; it was a favourite saying of his, that a king who would be great and reign well, ought to be more compassionate than another man.

Death of Christian. A. D. 1481.

John succeeds his father.

John, the eldest son of Christian, had been received as heir to the crown of Denmark, during the lifetime of his father; and the senate of Norway elected him their sovereign immediately after his father's death. As

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the states of Sweden did not seem disposed to proceed to the election of a sovereign, the senate of Denmark, in conjunction with that of Norway, sent deputies to hold a diet at Helmstadt, and invited the Swedes to do the same. At first the Swedes started many objections and difficulties, but ultimately they agreed to acknowledge John as their king, on condition that, to the articles of the union of Calmar, the following should be added: "That three senators of each kingdom should assemble every year to treat of such affairs as should concern the common interest of the three kingdoms; and that this assembly should be held successively one year at Kongsbakke; another at Leedese; and the third at Konselle;" places which, though in the neighbourhood of each other, were situated in the three kingdoms. The states of Holstein and Sleswick objected to continue under the dominion of the king of Denmark, and John was obliged to agree to a compromise, by which his brother Frederic shared with him the authority over these provinces. In 1490, John concluded a treaty of commerce with Henry the Seventh of England, by which their respective subjects obtained full liberty of free traffic with one another, on paying the usual duties on the merchandise which they sold. The English also bound themselves to pay the duties of the Sound, and engaged always to sail through this passage, and not through either of the Belts, except they were forced by a tempest; and in this case, they were to pay at Nyborg, the same duties which they would have paid in the Sound. The English merchants, by this treaty of commerce, were also permitted to have consuls in the principal maritime towns of Denmark and Norway. In 1499, John convoked an assembly of the states of Sweden at Upsal, for the purpose of having his oldest son, Prince Christian, elected his successor. The states agreed to this proposal, and bound themselves, in the most formal and solemn manner, not to elect any other prince after the death of John, but his son Prince Christian. Scarcely was this agreement entered into, before the Swedes were in open rebellion; and having joined the discontented party in Norway, two formidable armies took the field against their sovereign. To oppose these, John sent a large force into Norway, under the command of his son Christian, now 20 years of age: this kingdom was soon reduced to obedience, upon which Christian marched into Sweden, attacked the rebel army, and defeated it. On this occasion, the cruel and vindictive character of this prince first displayed itself; he behaved towards his prisoners in the most barbarous manner, so as to shock his own army, and again drive the Swedes into rebellion. Being convinced that they could now expect no mercy if they were conquered, the Swedes fought with the most determined and persevering bravery; and in order to remove one of the principal causes of their former misfortunes, they elected an administrator to govern the kingdom, who carried on the war against John with various success. Treaties were repeatedly made and broken by the contending parties; the Swedes expressing a wish to submit whenever they were hard pressed, and being again incited to resistance by the administrator, when they had recovered from their difficulties. In these wars with John, they were generally assisted by the people of Lubeck, who excelled in maritime affairs. Towards the end of the year 1510, a desperate engagement took place between the Danish and Lubeck fleets, in which the latter were worsted; the advantage thus gained by John, was, however, in some degree balanced by the success of the Swedes, who in 1511 took Bornholm.

John elected king of Sweden.

Treaty of commerce with England, A. D. 1490.

Rebellion of the Swedes.

In 1512, upon the death of the administrator, Sweden became a prey to domestic convulsions; and the people of Lubeck, tired of the war, took this opportunity to make peace with John. The Swedes, alarmed at this defection of their ally, agreed to appoint a congress, at which peace was concluded, on one of these three conditions, that Sweden should acknowledge John, or his son, for its sovereign; or that it should pay a tribute of 30,000 merks.

A short time before the death of John, which happened in the latter end of the year 1513, he was invited to enter into a league with James IV. of Scotland, and Louis XII. of France, against Henry VIII. of England; this invitation John was prudent enough not to accept; but as he did not wish to irritate the kings of Scotland and France by his refusal, he merely replied, that as James demanded speedy succours, and proposed to attack England immediately, he could not comply with this demand, since his senate, without whose consent he could not come to a resolution of such great consequence, were not with him, and he could not assemble them soon enough for the succours to arrive in good time.

Death of John, A. D. 1513.

The education of Christian II. who succeeded John, had not been such as to qualify him for the throne; he was boarded, during his infancy, with a citizen of Copenhagen, and afterwards with a clergyman of that city; who frequently took him into the great church to sing in the choir, with several young men of very low condition, who were his fellow-boarders. His learning was entirely neglected for several years, till at length he was put under the care of a preceptor from Brandenburgh, who taught him a little Latin. In his temper he was naturally irritable and violent, and this disposition was cherished, instead of being counteracted, by his being permitted to form connections, in his early age, with the most abandoned characters. The king, his father, was for a long time ignorant of his excesses, debauchery, and cruelty; and when he was informed of the manner in which his son conducted himself, his habits were so firmly fixed, that neither admonition nor chastisement produced any effect upon him. With all these faults, however, he was naturally courageous; and upon the rebellion breaking out in Norway and Sweden, he displayed considerable talents for military affairs; but, as has been already mentioned, the victories which he gained by his skill and courage, were rendered almost entirely fruitless by his subsequent tyranny and cruelty.

Christian II. succeeds his father.

Such was the character of Christian II. when he ascended the throne; no good was anticipated from it, and he soon gave unequivocal proof that his public conduct would be unprincipled and ferocious: his chief counsellors were his mistress and his drunken companions, people of the lowest rank, and of the most profligate manners. The states of Denmark were so apprehensive and alarmed, that they offered the crown to Frederic, duke of Holstein, the brother of the late king; but the offer was, at this time, not accepted; and the states, afraid of the vindictive spirit of Christian, kept it a profound secret, and acknowledged him king of Denmark and Norway, after he had bound himself to confirm the liberties and privileges of the two countries. At the assembly which was convoked on this occasion, deputies from Sweden were present; but they had not power to choose Christian king of Sweden; and by their representations on their return to their own country, induced the states of Sweden to declare openly against this prince, and to

Sweden declares against Christian.

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elect an administrator to hold the reigns of government. Christian, at first, did not attempt to reduce the Swedes, but contented himself with augmenting his power in Denmark; in effecting this, he was, however, opposed by the clergy and nobility, whom his natural disposition led him rather to oppose and oppress, than to conciliate; so that at the very time that he was at war with the Hanseatic towns, he found the great majority of his clergy and nobles at variance with him, and only waiting for a favourable opportunity to break out into open rebellion. Thus deprived, in a great measure, of the good will and support of his subjects, he resolved to strengthen and protect himself by other methods; and, with this intention and hope, he married the sister of the Emperor Charles V. He also perceived that commerce had introduced into Denmark a new order of men, whom, by encouraging their trade, and promoting their interests, he might possibly unite to himself in his opposition to the nobles and clergy; he accordingly gave many privileges to the merchants, and freed them from many vexatious impositions. Before his time, they were obliged to send all their merchandize to the Hanse Towns, at a very great expense, and to permit the magistrates of those towns, who were for the most part merchants, and therefore interested persons, to put a price upon their goods; the obvious and natural consequence was, that the Danish merchants were frequently obliged to sell their goods to a great disadvantage. In order to prevent these vexations, Christian issued orders that all the Danish merchants should send their goods to Copenhagen; and as they might be under apprehensions of his rapacity, he placed in the hands of the magistrates a very large sum of money. To induce foreign merchants to settle in Copenhagen, he granted them particular protection, and the most extensive privileges. While he acted with this wise policy towards all engaged in trade, towards the clergy, nobles, and the mass of the people, his conduct was tyrannical and oppressive: the revenue which an increased commerce gave him was principally expended in supporting a large number of regular troops; thus imitating the other sovereigns of Europe, who, about this time, first began to keep a standing army. With the assistance of these troops, he began to exercise his power with the greatest rigour, and to meditate the accomplishment of essential changes in the constitution, by the most violent and arbitrary means. At first the clergy and nobility were silent and inactive, through surprise and astonishment; and the king, thinking that they were intimidated, proceeded in his plans with still greater rapidity and boldness. Without the consent of the senate, and in direct opposition to the capitulations that had been signed by his predecessors and himself, he laid on new and oppressive taxes; and in order to strike terror, and silence the murmurs of the people, he ordered a gallows to be erected in the most public place in every town. In short, every action which he performed had for its object the breaking down the power of the clergy and nobles, and tyrannizing over the people: he still retained his mistress, and his profligate favourites, whom he consulted in all his schemes, to the utter neglect of the senate. Christian had been particularly blamed for his conduct to the nobility and clergy; but had he been moderate and just to the people at large, his conduct to these classes might have been excused; indeed it was almost called for by the circumstances of the times. The greatest part of the lands had fallen into the possession of the nobles, who were thus enabled to oppress the common people; while they had nearly in an equal degree touched on the prerogatives of the crown. Christian, therefore, seems to have had no alternative; he must either have submitted to have been the slave of his nobles, or have acted as he did, and reduced their power; he is, however, blameable, in that his measures were so oppressive and violent, and that his object was not to benefit the people, but himself.

His regulation in favour of commerce.

He perhaps would have found more difficulty in curbing the pride and reducing the power of the clergy, had not the doctrines of Luther begun to extend themselves about this time: of these Christian availed himself; and had he managed the opportunity with less violence, and with more caution and prudence, he might have completely annihilated the powers and privileges of the clergy; but the natural impetuosity of his disposition prevailed, and he incensed without materially humbling them. In the mean time, the affairs of Sweden were in the utmost confusion; the administrator, who had been just elected, was opposed by the clergy, with the archbishop of Upsal at their head, who formed a party to elect Christian king of Sweden. On the receipt of this unexpected and welcome intelligence, the king marched a body of troops to Schonen, under the command of Crumpen, an officer of great merit and experience. Although it was the depth of winter, such was the impatience of Christian, that he ordered Crumpen to enter West Gothland, and to endeavour to bring the enemy to battle. The administrator had not been idle; but having collected a numerous army, he marched to meet the Danes. Three battles were fought; the first decided nothing, in the second the administrator was wounded, and in the third the Swedes were completely defeated, the administrator dying soon after of his wounds. This success enabled Crumpen to march into the heart of the kingdom; and in the beginning of the following year, (1520) Christian, having arrived in Sweden, and Stockholm being reduced, he was formally proclaimed king. During his absence from Denmark, the discontented there flattered themselves with the hopes, that they should be able to organize such a force, as would enable them successfully to oppose him; but when he returned the conqueror of Sweden, they became silent and submissive.

Christian subdues Sweden, and is proclaimed king, A. D. 1520.

Christian soon discovered to the Swedes, that he meant to treat them as subjects of a conquered country. It had always been customary at the coronation of their kings, for the new monarch to make a certain number of knights; Christian complied with this custom in so far as to create the usual number, but they were all Danes and other foreigners; not a single Swede did he advance to that honour; and lest his motives might not be misunderstood, he publicly declared, that henceforward he would not shew any mark of honour to a Swede, "because he owed that crown to his arms and not to their free-will." This was only the beginning of his arbitrary and tyrannical conduct to this nation. Being embarrassed in his finances, and despairing of raising money with the consent of the senate, he formed a plan to massacre all the members of it. This plan is said to have been suggested to him by his mistress; it was communicated to the archbishop of Upsal, and received his sanction. The senate and the states of Sweden were accused of heresy, and were taken into custody on this accusation; but even the forms and delay of a mock trial were too slow for Christian's vindictive temper. He ordered the victims to be marched out in the middle of the day, surrounded by soldiers. Among the first was Eric Vasa, father of the

His cruelty to the Swedes.

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celebrated Gustavus Vasa. At the place of execution, 70 senators, lords, and bishops were executed; even then the cruelty of Christian was not glutted with blood. Being informed that several of those whom he had marked out could not be found, he ordered the soldiers to massacre all the people of rank whom they met in the streets, and to search the houses for them. A similar massacre took place in the provinces on all who were obnoxious to Christian, or had espoused the party of the administrator.

The Swedes under Gustavus attempt to recover their independeace, A. D. 1522.

But the day of retribution was at hand. Gustavus, son of Eric Vasa, roused the peasantry of the Swedish provinces, especially those of Dalecarlia, to attempt the restoration of their country's liberty and independence. In vain did Theodore the king's viceroy oppose Gustavus; he was compelled to return to Stockholm, which city, in the year 1522, was invested by the Swedish hero. To raise the siege, Christian sent a powerful fleet and army under Norby, who at first gained some advantages over the Dalecarlians, but was soon afterwards compelled to reimbark, having thrown supplies of men, stores, and provisions into the city. Gustavus, however, made little real progress in reducing it for want of a fleet. He therefore entered into a treaty with the inhabitants of Lubeck, who supplied him with a squadron. Stockholm was now reduced to such extremity, that Norby resolved to make another attempt to relieve it; he accordingly appeared before it with a large fleet, and attacked the auxiliary squadron of Gustavus. A storm put an end to the contest, and Norby taking shelter in a creek, his fleet was there fixed by a sudden frost, and thus exposed to the attacks of the enemy. In this situation, Gustavus resolved to attempt its destruction, but meeting with a formidable resistance, the Lubeckers retreated in the very middle of the battle. The ice was soon after dissolved, and Norby took advantage of this favourable circumstance to effect his escape.

Revolt in Denmark.

Denmark, in the mean time, was a scene of the utmost confusion, and the province of Jutland was in a state of open revolt. A general diet was held at Wyburg, by which Christian was formally deposed, and a particular decree passed, stating the reasons for this proceeding. As soon as the king was informed of his deposition, he set out for Kolding, a town situated on the frontiers of Holstein and Jutland. Copenhagen, the islands of the Baltic, and Norway, were still in his power; but as he was conscious that he held them by a frail and uncertain tenure, and that from them he could not expect to draw the means of quashing the rebellion in the other parts of his dominions, he formed the resolution of abdicating the throne. Before he put this resolution into practice, however, he went to Ringstadt, where there happened to be a great fair; here he harangued the populace with such effect, that they took a fresh oath of allegiance, and offered to assist him against all his enemies; but he was now grown distrustful, and being apprehensive that if he delayed any longer, he should not be able to escape from Denmark, he resolved on immediate flight, and retired with his family into the Low Countries.

Christian abdicates the throne,

And retires to the Low Countries.

Character of Christian.

The character of this prince has been already sketched, and indeed it is sufficiently apparent from the whole tenor of his political life; yet cruel and tyrannical as it undoubtedly was, many of his measures displayed considerable wisdom and a sense of justice. In the year 1521 he published a code of laws, which greatly limited the power of the nobility over their vassals, and retrenched several branches of their revenues. By this code they were expressly forbidden to sell their vassals as slaves. The article which relates to this traffic exhibits a dreadful picture of the state of the peasantry at that time: "The wicked and impious practice, which is followed in Zealand, Falster, Laaland, and other parts of Denmark, of selling the poor farmers, and of making a traffic of Christians, shall be abolished for ever; and when the proprietors of lands shall use their vassals with injustice, the latter shall be permitted to leave the lands of the former, and to settle themselves in other lands, as is the custom among the farmers in Scania, Jutland, and Funen." In the same year he published a code of ecclesiastical laws, in which it is declared that a bishop shall not have more than 14 persons in his train when he is on a journey, and an archbishop not more than 20. Before the passing of this law, these prelates were generally accompanied with 100 knights and other attendants, who treated the common people with great indignity, cruelty, and oppression. Another law which he passed shall be noticed, because it not only throws great light on the customs and the state of society of Denmark at this æra, but also exhibits the character of Christian to great advantage. By this law, the practice of robbing and plundering ships which had been wrecked, was forbidden. It was expressly ordered, that all the king's officers should assist the seamen to the utmost of their power, in saving the ships and cargo; if they refused, they were liable to be hanged, and to have their goods confiscated; if all the seamen were drowned, the countrymen were obliged to keep the effects saved from the wreck, for a year and a day; and if within that period the owner claimed them, they were to be given up to him upon his paying salvage; if they were not claimed within a year and a day, they were to be divided, and two thirds were to be the property of the king, and the other third the property of the curate of the parish. Even the wages of those who might be employed in saving the effects was fixed by law; and if the owner of the ship was forced to sell any part of the cargo in order to pay these men, the king's officer was obliged to render to him faithfully all the money that might arise from such sales; if he did him injustice, he was liable to suffer death.

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Wisdom of his enactments.

This law was particularly disagreeable to the Danes, especially the nobility and clergy. Before it was passed, many of them made a considerable revenue by plundering ship-wrecked vessels. The bishops of Borghum in Jutland frequently employed 300 men on the sea coasts, when there was any appearance of a tempest which might drive ships ashore, in order to compel the seamen to suffer their goods to be plundered without making any resistance, or if they made resistance, to massacre them. "Herman Grice, one of the senators, having represented to the king the wrong which he did himself by this law, as he would lose thereby a considerable revenue from Jutland alone, besides what he would lose in the other provinces, Christian returned him the following answer: "I would rather lose all the revenues of which you speak, than suffer those unhappy people to be so unjustly treated." One of the bishops likewise complained to the king of the wrong which he had done him in particular by this law, and demanded permission to follow the ancient customs of the country with regard to this matter; to which Christian answered, that his intention was not to make any change in those customs, except in such as he found to be contrary to the divine laws; whereupon this conscientious prelate replied, by ask-

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ing, "How the ancient customs of the kingdom, respecting shipwrecks, were contrary to the divine laws?" To which the king again replied, "Thou shalt not kill, thou shalt not steal."

Frederic Duke of Holstein proclaimed king of Denmark.

As soon as the flight of Christian was known to Frederic Duke of Holstein, his uncle, he entered Jutland, where he was proclaimed king: the capitulation which the clergy and nobility obliged him to sign, limited and controuled his power exceedingly, while it extended their privileges and rights. By all the former capitulations, which the Danish sovereigns had signed, these orders of men had never been able to obtain a legal sanction to the right which they claimed over the lives of their farmers; all they could obtain was the right of judging them for small offences; but by one of the articles of the capitulation, which Frederic signed, the nobles obtained, formally, not only the right of life and death over their farmers, but also that of condemning them to lose all their goods, whenever they supposed that they had acted illegally: this power the king could not in reality bestow, since by the fundamental laws of the constitution of Denmark, the farmers formed a distinct order of the state, and had always been recognised, though not always treated as such. The oppression and tyranny to which this extended right of the nobility gave rise, was so galling and insupportable, that the people began to entertain those feelings and sentiments which afterwards made them concur in that revolution, which entirely changed the constitution of Denmark. In a letter written about this time by a Danish ecclesiastic to his friend, published by Pontoppidan, it is expressly stated, that "the people in general are of opinion, that they had better suffer patiently the tyranny of one person, than have so many tyrants at a time, whose insatiable avarice and pride are not to be borne." With respect to the clergy in particular, they obliged Frederic to burn that law of Christian the Second, which prevented the robbing of vessels that were shipwrecked, as contrary to the laudable customs of the country. As soon as Frederic felt himself secure in the throne, he turned his thoughts against Sweden; at first he entertained hopes that he should be able to deprive Gustavus of that kingdom; and for that purpose he sent ambassadors to the Swedish senate, complaining of the election of that monarch, in prejudice to his superior right, and in direct violation of the union of Calmar. But the Swedish nation were too well satisfied with Gustavus, to feel any inclination to dethrone him, and too conscious of their own power to be apprehensive of the designs of Frederic. When the Danish ambassadors opened their business before the diet, the members of it not only refused to give them any countenance, but they openly declared before them, that they would extend the privileges of Gustavus beyond what any former monarch had possessed, by granting the power to declare peace and war. Gustavus, on his part, treated the ambassadors with great attention and respect; but in order to impress upon their minds the state of preparation for war in which he had placed Sweden, he reviewed the troops before them, and carried them to inspect the arsenals, &c. In consequence of the report of the ambassadors, and of the behaviour of a skilful agent whom Gustavus sent to the court of Copenhagen, an alliance was formed between the two monarchs. But shortly afterwards, a cause of difference arose between them: Norby, who commanded the Danish fleet, refused to acknowledge Frederic, commenced pirate, and committed great ravages on the shipping of Lubeck and the other Hanse Towns: they complained to Gustavus, who resolved to chastise Norby, and at the same time attempt to gain possession of the isle of Gothland, in which the admiral had taken shelter, and which had formerly belonged to Sweden. Norby now expressed his willingness to submit to Frederic, provided he would protect him from the Swedes: the admiral was accordingly relieved; but disputes arose between the two monarchs respecting Gothland; and the Swedish monarch besieged Wesby, the principal town in the island. Frederic, however, having thrown considerable supplies into it, Gustavus, convinced he could not reduce it, raised the siege.

The wise enactments of Christian repealed.

Alliance between Gustavus and Frederic.

In 1526, an attempt was made to reinstate Christian by Margaret of Austria: for this purpose she sent some ships into the Baltic, but nothing was effected. Frederic's attention at this time was principally occupied by the religious disputes which arose in his kingdom: he himself had embraced the Protestant religion, but the nation was divided into two parties, filled with the most bitter rancour against each other. The policy of Frederic on this occasion was liberal and enlightened: he published an edict, prohibiting all his subjects, under very severe penalties, from laying any restraints on conscience, or in any manner depriving a man of his fortune, reputation, or liberty, on account of his religious opinions; the doctrines of the reformed religion were also permitted to be preached openly, without the least molestation. This edict was soon afterwards ratified at a general diet of the states, at which it was also decreed that the religious of all orders should be permitted to marry, and live in any part of the kingdom they thought proper, without respect to particular monasteries, &c. In consequence of this decree, the abbeys and cloisters were deserted: Lutheranism now spread rapidly; the city of Malmo publicly prohibited mass, and the other superstitions of the Romish church; and its example was soon followed by the other cities and towns: the New Testament was also translated into the Danish language.

Religious disputes.

Universal toleration established by law.

The progress of the reformed religion, and the countenance and support which Frederic gave to it, rendered him very obnoxious to the clergy; and Christian, informed of the state of Denmark, resolved to make another attempt to regain the throne. He was enabled, by the assistance of the emperor, his brother-in-law, to raise a considerable force in the Netherlands, with which he invaded Norway: at first he gained a footing there, and was joined by all the malcontents, especially by those who still adhered to the Roman Catholic religion. Frederic was alarmed, and sought the assistance of Gustavus and of the Landgrave of Hesse, both of whom, principally because they considered the cause of the reformed religion might be injured by the success of Christian, sent him powerful reinforcements. At the same time, Frederic equipped a fleet, which came up with Christian's fleet before Babus: here they attacked them: the engagement continued the whole day, when it ended in the total destruction of the fleet, which had brought Christian from the Low Countries to Norway. Thus cut off from all chance of escape by sea, this unfortunate prince endeavoured to penetrate into Sweden; but in this attempt he was opposed by a body of 3000 Swedish horse. He was soon afterwards compelled to surrender, the Danish generals engaging themselves to grant him a safe passport into the Netherlands; but this engagement was most shamefully broken; Christian was carried to Soldenberg, in the isle of Alsen, where he was shut up in a dungeon, with only a dwarf

Christian attempts to recover the throne.

Is defeated,

And surrenders.

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to keep him company; the door of the dungeon was immediately walled up, only one small window being left, which served both to give light to the place, and to convey provisions to the prisoner. Here he continued till the death of Frederic, which happened at Gottorp in the year 1533.

Frederic dies, A. D. 1533.

Frederic left two sons, Christian and John: the latter had been brought up in the Catholic religion; the former was a Protestant. The bishops, who had repented of their opposition to Christian the Second, when they perceived that Frederic favoured the reformed religion, were desirous that John should succeed his father. As soon as Frederic's death was known, the senate convoked the deputies of the different orders of the states at Copenhagen. The bishops opened the debate, by inveighing, with great zeal and warmth, on the subject of religion; and when they found that the lay senators did not coincide with their opinions, they demanded that the decree of the diet of Odensee, which had given the nobles such extensive power over their farmers, should be annulled: the nobility were alarmed, and endeavoured to sooth the clergy, but the latter feeling their weight in the assembly, carried their point so far, that the tenths were restored to them. The next subject discussed related to the choice of a successor to Frederic; the Catholic and ecclesiastic senators declared for John; the lay and Protestant senators for Christian; debates ran high, till at last it was proposed that the states of Norway should be invited to send their deputies. Although these were all Roman Catholics, yet the proposition was so fair, that the Protestant senators could not object to it. The bishops considering the election of John as now secure, began to persecute the reformists, and to harass the people with heavy taxes. The friends of Christian the Second, considering this a favourable opportunity to endeavour to reinstate him, made an attempt to that effect; but this attempt, though at first successful, ended in the election of Christian the Third: for the bishops, alarmed at the endeavours to reinstate Christian the Second, and perceiving that their former conduct had incurred the indignation of the nation at large, consented to the election of Christian the Third, on the condition that the privileges and rights of the senate and states should be confirmed, and that he should not be the enemy of their religion. The rights of all classes, except those of the farmers, were amply secured by the capitulation which Christian signed, when he ascended the throne; but the farmers were, if possible, in a still worse and more oppressed condition than they had ever been before.

Disputes respecting the succession.

Christian III. elected king.

Christian found the state of public affairs such as required the display and exercise of considerable energy and activity, united to moderation and forbearance: the differences on religious subjects still existed; the army that had been sent to reinstate Christian the Second, was still in possession of some part of the Danish dominions, and had been joined by all the discontented. The province of Fioni demanded his first and principal attention: the Count of Oldenberg, who was at the head of the invading army, had reduced nearly the whole of it, and though it was restored by a victory which Christian gained over this general, yet no sooner did the king leave it to prosecute the war in other parts, than the Count returned, and being assisted by the whole body of farmers, again subdued the whole province, and made them take a new oath of fidelity to Christian the Second. In this situation of affairs, Christian the Third had recourse to the King of Sweden, who coming himself at the head of a large force, turned the fortune of war in favour of his ally. The troops of the Count of Oldenberg were soon driven out of Jutland, and afterwards out of Fioni, by Christian's army; while Gustavus reconquered Scania. The Count was now obliged to act on the defensive, and to retire into Zealand, where he shut himself up in Copenhagen. The siege of this place was immediately undertaken: it made a long and obstinate defence, but at last it was reduced, and the Count of Oldenberg was taken prisoner.

State of religion.

As soon as Christian the Third was firmly seated on the throne, he turned his attention to the state of religion; and resolved to carry into execution a plan which had been communicated to him by Gustavus, for reducing the power of the clergy. He accordingly assembled the senate with great secrecy, and they immediately came to the resolution to annex all the church-lands, towns, fortresses, and villages, to the crown, and to abolish for ever the temporal power of the clergy. All the bishops in the different parts of the kingdom were arrested about the same time; and that the nation might not be alarmed by this extraordinary measure, the king convoked the states at Copenhagen; the nobility were ordered to be there in person, and the commons by their deputies, but the clergy were not summoned to attend. After a strong speech from the king against the rapacity of the clergy, the senate confirmed the decree of the diet, and the power and privileges of the clergy were declared to be annihilated for ever. The senate next settled the succession in the person of Duke Frederic, the king's eldest son. In return for these concessions, the king confirmed the nobility in all their rights, particularly in what they called the right of life and death over their vassals, and of punishing them in what manner they thought proper. Thus was the power of the clergy for ever destroyed in Denmark; but the conclusion which the nobles drew from this, that their own authority and power would be so much the more augmented, was soon proved to be erroneous; for as a great part of the crown-lands had fallen into the hands of the clergy, these lands being again annexed to the crown, the royal authority was considerably increased. The oppression of the farmers still continued, and the nobles displayed a restless and increasing desire to prevent them from ever rising in the state; for the senate passed a law, forbidding any person, either ecclesiastic or secular, who was not noble, to buy any freehold lands in the kingdom, or to endeavour to acquire such lands by any other title.

Disturbances in Norway, A. D. 1536.

Norway was still unwilling to acknowledge Christian; the Catholic religion kept its ground there longer and more firmly than it did in Denmark. The states of the former kingdom being assembled at Drontheim, in the begining of the year 1536, Christian sent notice to them that he was king of Denmark, and demanded, by virtue of the union of the two kingdoms, to be elected their king also; but the clergy representing this demand as haughty, and the presage of a tyrannical government, the people rose in a tumultuous manner, massacred several of the king's friends, and compelled the rest to quit the kingdom. Christian on this resolved to have recourse to the most decisive measures. He accordingly marched an army into Norway, and before the end of the year, the whole kingdom was reduced to a state of obedience and tranquillity. The Danish nobility persuaded the king to take advantage of the subjugation of Norway, to strip this kingdom of its independence; and a decree was accordingly passed, stating, that as the kingdom of Norway had declined in

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Norway annexed to the crown of Denmark.

its power and resources, so as to be no longer capable of supporting a king; and as the greatest part of its senators had shewn themselves enemies to the crown of Denmark; therefore the said kingdom of Norway shall be, and for ever remain subjected to the crown of Denmark; so that in future it shall no more be a kingdom a part, nor shall it any more be so called, but shall be a part of the kingdom of Denmark. It was, however, stipulated, that in case Norway should be engaged in war, the senate and the estates of Denmark should assist them. This decree was carried into immediate and full execution. The senate of Norway was suppressed, the states no longer had any influence in the elections, and the Danish nobility were appointed to most of the places of confidence and emolument in that kingdom.

Christian III dies, A. D. 1558.

In 1546, Christian the Second publicly and formally renounced all his claims to the crown of Denmark, binding himself never to go out of the fortress of Cattenberg but with the king's consent, and to hold no communication with strangers. Nothing else remarkable occurred during the reign of Christian the Third, who died on the 1st of January 1558.

Frederic II. elected king.

He was succeeded by his son Frederic the Second, who greatly resembled him in disposition and character. His first warlike enterprize was against that part of the Duchy of Holstein, called Ditmarsh, the inhabitants of which refused obedience to the kings of Denmark, or the Dukes of Holstein. In his war against these people, he was joined by Count Rantzaw and Duke Adolphus, who, from the vicinity of their territories to Ditmarsh, were interested in the quarrel. The confederates first attacked and carried by assault the city of Meldorp; they next proceeded to Heida, where the Dithmarsian army suffered a total defeat. Peace was soon afterwards granted to this people, on condition that they should do homage to the kings of Denmark and Dukes of Holstein; that the forts erected by the Dithmarsians should be destroyed, and that the confederate princes should have liberty to build three forts in any part of the country they chose. In 1563, in consequence of some trifling disputes between Frederic, and Eric who sat on the throne of Sweden, hostilities commenced between the two countries. Frederic on this occasion formed an alliance with the inhabitants of Lubeck, who had long been at variance with Sweden, on account of the restrictions which that government had imposed on their trade. After a maritime engagement, in which the Danes were the aggressors before any formal declaration of war, and in which they were worsted, Eric, either naturally of a pacific disposition, or alarmed at the great preparations of his opponent, made offers of peace. These were refused by Frederic, who had now an army of 80,000 infantry, a large body of horse, and a strong fleet, besides the squadron of his allies, the Lubeckers. The whole operations of the first campaign, in 1563, consisted in the reduction of Elfsburgh by the Danes. During the winter, the Elector of Saxony and the Prince of Hesse endeavoured to negociate a peace, but the offer was now declined by Eric. As soon as the spring permitted it, the hostile fleets put to sea; an engagement took place, and the Swedes were totally defeated: nor was Eric more successful in his invasion of Norway, from which kingdom his army was obliged to flee with a disgraceful and ruinous rapidity. He was not, however, dispirited; and having collected a large fleet, a desperate engagement took place between Wismar and Rostock; it lasted for three days; both sides fought with great obstinacy and skill; on the third day the Danish admiral was taken; this decided the batle; and for the remainder of the year the Swedes remained masters at sea. The war also raged by land. Eric commanded his army in person; and after several partial engagements, a decisive battle took place near Wardeburgh. The Danish army was commanded by Count Rantzaw; it was much inferior in number to the Swedes. Eric trusting too much to this circumstance, quitted an advantageous post, attacked the Danes in a narrow defile, where his numbers could be of little advantage, and was defeated with the loss of 7000 men, and all his artillery. The Danes, however, gained little by this victory but glory; and the war continued with increased rancour, and with various success. Eric, towards the end of 1566, was persuaded to invade Norway, by the representations of a person who called himself a Norwegian noble, and who persuaded the king that his countrymen were ripe for revolt. Eric soon found that he had been deceived, and he was compelled to retire from Norway, after suffering a severe defeat. In 1568, a civil war broke out in Sweden; and the malcontents concluded a peace with Denmark, on terms very injurious to their own country. The war was renewed, and carried on with great bitterness, but with little success on either side, in 1569, till the end of the following year, when a more equitable and permanent peace was concluded. The Danish monarchs having gradually increased the duties of the Sound, and having frequently exacted them with unnecessary strictness and rigour, the English, Dutch, Lubeckers, and Hanse Towns, remonstrated against them entirely, in the year 1583; but their remonstrances were in vain, and they were under the necessity of submitting to the mode and extent of these exactions. Towards the conclusion of Frederic's reign, Denmark began to rise in importance among the European powers. An embassy came from Elizabeth, Queen of England, with the order of the garter for the Danish sovereign; and in 1588 a treaty of marriage was proposed between a Princess of Denmark and James the Sixth, King of Scotland. Soon after this, Frederic died, in the 54th year of his age, and in the 29th of his reign.

Disturbances in Holstein.

War with Sweden.

Naval engagement, in which the Swedes were victorious.

The Swedes defeated near Wardeburgh.

Norway unsuccessfully invaded by Sweden, A. D. 1566.

Peace concluded, A. D. 1570.

Death of Frederic, A. D. 1588.

Regency during the minority of Christian IV.

Christian the Fourth was only eleven years old when his father died; a regency was therefore appointed, who performed their duty both to the young prince and to the kingdom in the most exemplary manner. Every measure was taken which could ensure the proper education of Christian, and the tranquillity and prosperity of the people. As soon as this prince assumed the royal power, he directed his thoughts and his preparations to a war with Sweden; the pretexts that he urged for commencing this war, were rather frivolous. Charles the Fourth, who then sat on the throne of Sweden, had assumed the title of King of Lapland; this gave great offence to his Danish majesty, who regarded Lapland as a dependence on Norway; and in his declaration of war, this grievance was strongly held forth. Hostilities commenced, on the part of Christian, by the siege of Calmar in 1611. The city was soon taken, but Charles, with an army of 16,000 men, defeated the Danish general in the absence of the king, and obliged him to raise the siege of the citadel. As soon, however, as Christian returned, the siege was renewed, and the citadel surrendered. Bornholm and Oeland also yielded to the Danes; and Charles, irritated at these disgraceful disasters, challenged Christian to single combat; the challenge was contemptuously refused; and this circumstance is supposed to have occasioned, or hastened the death of the Swedish monarch. He was

War with Sweden, A. D. 1611.

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succeeded by the famous Gustavus Adolphus, who turned the fortune of the war; and in 1613, a peace was concluded by the mediation of the King of England. From 1614 to 1623, Denmark was at peace; and Christian turned his whole attention to the encouragement of trade and commerce. In 1621, a treaty of alliance was concluded between the Kings of England, Denmark, and Sweden, several of the princes of the empire, and Holland. The object of this treaty was to support the Elector Palatine, in whose favour, in 1623, Christian took up arms, and was appointed head of the league, and commander of the forces of Lower Saxony. He was, however, not equal in military talents or experience to the Imperial general, Count Tilly, by whom he was completely defeated near Rottenburgh, in 1626. His infantry being entirely cut to pieces, he was compelled to retreat with his cavalry, continually harassed by the enemy, who followed him into Holstein. In a very short time the whole of this province fell into their hands; and when Christian attempted to prevent their entrance into Jutland, he was deserted by his troops. The people now suffered severely under the exactions and ravages of the Imperial troops, while the senate in vain endeavoured to bring about a peace. Christian, convinced that he ought to prepare for the worst, renewed his alliance with England, Sweden, and Holland; and having fitted out a fleet, he recovered part of his dominions. Both sides were now tired of the war, and peace was concluded on condition that his Imperial majesty should not interfere in the affairs of Denmark; that all the places taken from Denmark should be restored; and that his Danish majesty should cede to the Houses of Sleswick and Gottorp all the territory which belonged to them by hereditary right. In 1630, a dispute arose with the city of Hamburgh, in consequence of Christian bestowing on Gluckstadt several important privileges, and imposing duties on all vessels that sailed up the Elbe. The dispute was carried on with great acrimony; and notwithstanding the endeavours of Lubeck and Bremen to reconcile the parties, hostilities commenced. Christian assembled a large fleet at the mouth of the Elbe, and was preparing to attack Hamburgh, when he thought proper to desist from his enterprise, in consequence of his apprehension or jealousy of the king of Sweden. The Imperial court, which at this period was greatly alarmed at the brilliant conquests of Gustavus in Germany, were very anxious to foment the differences between him and Christian; Pappenheim, the Imperial general, succeeded in irritating Christian against the king of Sweden; but the Danish senate suspecting his design, prevented a rupture between the two countries. In 1632, Christian offered his mediation to restore peace to Germany; but as he was suspected of favouring the court of Vienna, Gustavus declined the mediation. In 1637, the world was astonished by a chimerical enterprise of the Danish king, at once to ruin the commerce of Holland, and to conquer Sweden. In this most rash and absurd undertaking, he was to be joined by Spain and the duke of Holstein; and the former actually embarked a great number of troops; but the whole scheme was defeated by the victory that Tromp, the Dutch admiral, gained over the Spanish fleet in the British Channel. At the moment, Sweden concealed her indignation at this scheme of Christian's; but no sooner had she begun to negociate a peace with his Imperial majesty, than general Torttenson entered Denmark with a powerful army, and advanced as far as Jutland without resistance: in this province he was opposed, but with such inadequate means, that he soon conquered nearly the whole of it. Hitherto Sweden had assigned no reason for this sudden commencement of hostilities; but as all Europe was astonished and indignant at her conduct, she issued a manifesto, in which she exposed the clandestine treaty, which Denmark had formed with Spain and Holstein. The Swedes still continued to advance, and count Horn, who now commanded them, prepared to invade Funen and Zealand; but Christian, recovered from his surprise, had put the fortresses into such a good state of defence, that the Swedish general was obliged to desist from his enterprise. Christian, perceiving that the enemy, though prevented from advancing and extending their conquests, still retained those which they had made, resolved to march himself at the head of a powerful army into Sweden. He accordingly crossed the Sound, and laid siege to Gottenburgh, while a large fleet blockaded it by sea. Horn upon this evacuated Denmark, and marched to raise the siege; this he probably would not have been able to effect, had he not been assisted by the Dutch, who sent a fleet for this purpose. Christian soon afterwards solicited the mediation or the assistance of his Imperial majesty, who, after some delay, took effectual measures for the protection of Denmark. France, about the same period, offered her mediation, which was accepted; but before the terms were adjusted, the Danish fleet suffered a most severe defeat off the isle of Femren. The Danish admiral, vice admiral, and 12 ships of war, were taken, and 4000 men killed; several more ships were run on shore; so that of the whole fleet, only two got safe into port. At length, in 1645, peace was concluded, by which Sweden obtained the islands of Gothland and Oesel, the provinces of Jenetland, and Harndalen, which had belonged to Norway, and the possession of Halland for 30 years: this last was given as a full security of the right of navigation and commerce in the Sound and Great Belt; on the other hand, Sweden restored to Denmark all the cities, &c. which had been conquered during the war. From the conclusion of this peace till the death of Christian, nothing memorable occurred. He died in the month of February 1648, at the age of 71, and in the 60th year of his reign.

"Christian was possessed of admirable qualities of mind and body, but had a vindictive obstinacy of temper, which made him pursue his animosities beyond the dictates of prudence. To his last day he retained all the fire and vehemence of youth; commanded his fleets and armies in person, after he had worn the crown nearly sixty years; threw himself in the midst of dangers, at an age when the faculties of the mind and body are usually enervated; was to the last jealous and tenacious of the dignity of the crown, and the happiness of his people; though too strict a regard for the former proved all his life the destruction of the latter. On the whole, however, he was a monarch of an able head, strong arm, extensive capacity, and great magnanimity, qualities unhappily tinctured with violent passions, which frequently obscured every ray of understanding, and locked up the exertion of that solid reason with which nature had endowed him." His memory is still held in great esteem and reverence by the Danes. In his reign, the Danish settlements in the East Indies, and the Danish joint companies trading to Greenland and Iceland, were established.

Christian left many children, but only one that was legitimate, a son named Frederic; he of course had a right to the throne: but many of the Danish nobility

Peace concluded, A. D. 1613.

War with the Emperor of Germany.

Christian defeated by Tilly, A. D. 1626.

Peace restored.

Dispute with Hamburgh, A. D. 1630.

Rupture with Sweden, A. D. 1637.

Defeat of the Danish fleet.

Peace established, A. D. 1645.

Death of Christian, A. D. 1648.

His character.

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were disposed to elect Valdemar, one of his natural sons, in the expectation that if he were king, he would be disposed, in return for the dignity to which they had raised him, to extend their privileges. It has been already seen, that the privileges of the nobles were enlarged by almost every monarch; and the power and presumption with which they were thus invested, were much increased, by the circumstance, that almost all Christian's illegitimate daughters were married to Danish noblemen. Frederic, alarmed at their disposition to prefer Valdemar, agreed to accept the throne upon any conditions that they would prescribe. They accordingly insisted, that they should be freed from the payment of the usual contributions towards the support of government; that all posts of honour and profit should be exclusively bestowed upon them; and that the commons should be excluded from all military preferment above the rank of captain. Articles to this effect were inserted in the capitulation which Frederic signed; and this monarch thus ascended the throne, a greater slave to his nobility than any of his predecessors. The state of Denmark at this period required a monarch of great talents; firmness, economy, and moderation, were absolutely requisite; the army of Denmark had been nearly annihilated by the wars in the last reign; her marine was in a condition little better than the army; there was scarcely any money in the treasury; the nobles were exempted from the payment of taxes; and the people were so poor, or so discontented, that to levy the necessary taxes on them would have been impracticable, and the attempt excessively dangerous. The states of Norway seemed disposed to throw off their dependence on Denmark, and assume a republican form of government; and Sweden was evidently preparing to take advantage of the reduced and humble condition of her rival. The first object of Frederic was to arrange with the Dutch respecting the payment of the Sound duties. Frequent disputes had arisen with this commercial people on that subject; and the maritime assistance which, during the preceding reign, they had afforded to Sweden, may be traced, in some measure, to the circumstance of the Danes having increased these dues. A treaty was therefore formed between Denmark and Holland, consisting of two parts: By one part, called the redemption treaty, the Dutch agreed to pay 150,000 florins yearly, for the free passage of the Sound. This treaty was objected to by the Danish ministry and merchants, and even by the Dutch merchants themselves. The ministry contended, that the revenue, which might fairly have been drawn from the dues levied on the Dutch ships which passed the Sound yearly, would have been double the redemption sum. The merchants were apprehensive, that if the public revenues were not sufficient, and the government should be under the necessity of laying on other taxes, these taxes would fall upon them; and the Dutch merchants complained, that their interests had not been sufficiently attended to. The other part of the treaty was one of alliance, by which each power bound itself to furnish the other with 4000 men, in case it was attacked. This last treaty Frederic was soon called upon to fulfil. In 1652, the Dutch envoy at Copenhagen called for the stipulated forces, in consequence of an approaching war between Holland and England; but the Danish monarch hesitated to comply, as he contended that the Danish envoy had not proved that England had been the aggressor. He was also apprehensive, that if he assisted Holland, Sweden would unite herself with England.

Frederic elected king.

Treaty with the Dutch.

A. D. 1652.

The Dutch were extremely anxious to gain the assistance of Frederic, who resolved to take advantage of their anxiety to gain a large subsidy from them. In the mean time, to convince them that he was disposed to adhere to the treaty, he seized a large fleet of English merchant vessels, which, at his own request, had put into Copenhagen, in order to secure themselves from the Dutch fleet, which was cruising in the Sound. Cromwell was by no means disposed to put up with this treacherous conduct, and Bradshaw was accordingly sent to Copenhagen to remonstrate with Frederic. The Danish monarch seemed disposed to listen to Bradshaw. The Dutch were alarmed, and immediately consented to another treaty with him, by which they were to pay 150,000 rix-dollars, on condition that the king assisted them with a squadron of 20 sail. This squadron Holland did not demand; but by Denmark thus engaging in war with England, this latter power was prevented from getting her usual and regular supply of naval stores from the Baltic.

In 1655, the jealousies between Sweden and Denmark increased. Charles Gustavus was now on the throne of the latter kingdom, a monarch in the prime of life, of great and aspiring ambition, and of considerable enterprise and talents. Soon after his accession, he carried on a war in Poland, in which he was very successful. Frederic was alarmed at his conquests, and apprehensive that, if he possessed himself of the southern coasts of the Baltic, the Danish commerce would be greatly injured. Charles was at this time laying siege to Dantzic: Frederic and the United States, who were equally interested in stopping his further progress, agreed to send a united fleet. A Dutch squadron accordingly entered the Baltic; but Frederic delayed uniting his fleet to it, till he ascertained whether Charles was likely to be still successful. As soon as he heard that the Swedish monarch had met with some reverses, he determined to declare war; but he was surprised and embarrassed when the Dutch fleet returned home; and soon afterwards the United States concluded a treaty of peace with Sweden. He remonstrated against their conduct, but with no effect: the government adhered to the treaty; but the merchants fitted out private ships of war against the Swedes. This latter circumstance encouraged Frederic, who now openly declared war against Charles: an army was sent into Bremen, on which province he stated himself to have some pretensions; and the king sailed with a large fleet for Dantzic. The Danish army was defeated; and the fleet returned to Copenhagen without accomplishing any thing.

A. D. 1655.

War with Sweden.

The King of Sweden, on receiving intelligence of the Danish declaration of war, left Poland, and entered Holstein, where his progress was rapid; four regiments of Danes were made prisoners of war; the whole of this province was reduced, and he prepared to advance into Jutland. Before, however, he could do this, it was necessary to reduce the fortress of Frederics-Odde, which was remarkably strong and well garrisoned. Finding that the reduction of this place would require some time, he left Wrangel in command of the blockading army. This general, sensible of the great importance of its speedy capture, resolved, if possible, to carry it by assault. An hour before day-light, the assault was made, and the Swedes were masters of the place almost before the garrison were roused from their sleep. Frederic was not more fortunate by sea. The Swedish fleet, consisting of twenty-six men of war, fell

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in with the united Danish and Dutch squadrons; the action commenced and was continued with great obstinacy, but the Dutch deserted their allies; in consequence of this, the Danes gained only a doubtful and indecisive victory. The reputation, talents, and success of the king of Sweden, alarmed the United States, and several other of the powers of Europe; they were therefore disposed to assist Frederic against him; and Charles, sensible of this, determined to attack Denmark in its most vital part, and with all his force, before it was assisted. Accordingly, early in February, he crossed the Little Belt on the ice, entered the isle of Funen, defeated a considerable body of Danes, took Odensee, the capital of the island, and then resolved to march across the ice to Zealand. This bold and daring enterprize he accomplished, and marched immediately against Copenhagen. To defend the city, there were not more than 4000 men, consisting of 2000 horse, and 800 regular infantry; the remainder were made up of gentlemen, peasants, and sailors. General Krempen, who commanded this force, offered to set fire to the suburbs, attack the king of Sweden, who was at Keuck, and reduce that place to ashes. Frederic approved of the scheme, but it was rejected by the senate. The situation of Frederic in Copenhagen was extremely critical: the walls of the city were in a most ruinous condition; the supply of provisions, ammunition, and stores, was small; it was crowded with peasants, who had fled thither on the landing of the Swedish army, from all parts of Zealand; and the nobility were clamorous and discontented. Under the pressure of all these unpropitious circumstances, Frederic retained his firmness and presence of mind: his talents rose in proportion as they were required. In this emergency, he was greatly assisted by the prudent advice, and encouraged by the resolution and constancy, of his queen Sophia Amelia, princess of Brunswic-Luneburg. For nearly two years Copenhagen was blockaded by a powerful and victorious army; at length famine threatening the inhabitants, Frederic was induced to send a person to Torstrick, where Meadows, Cromwell's envoy, was endeavouring to negociate a peace. On the 28th of February 1651, peace was concluded, Frederic yielding up to the Swedes, Halland, Schonen, Blekingen, the island of Bornholm, the citadel and fief of Bohus, and the bishoprick of Drontheim. As the Swedish army was still in Zealand, Frederic was advised to refuse the cession of Schonen, till it was evacuated. This refusal irritated Charles, and he immediately sent part of his army to invest Copenhagen. Hostilities would have undoubtedly recommenced, had not the mediators interfered, and given the Swedish monarch such strong assurances of Frederic's sincerity, that an interview took place between the monarchs, on the most unsuspicious and friendly footing.

The Swedes blockade Copenhagen.

Peace concluded, A. D. 1651.

The greatest part of the Swedish army still remained in Zealand; and it was soon apparent, that the friendship of Charles was not to be depended upon, and that he was diligently in search of some plausible pretext for the renewal of hostilities. He complained, that Frederic had not complied with the treaty in some trifling points; and to enforce, or expedite compliance, as he alleged, he entered Holstein with his army. His ultimate object was for some time not suspected, till he persuaded the duke of Holstein to apply to the governor of Rendsbergh to put that fortress into his possession; on the governor's indignantly refusing to accede to this application, Charles landed his army in Zealand, and, with the forces already there, proceeded to block up all the roads leading to Copenhagen. A fleet at the same time blocked up the harbour; and on the 10th of September 1658, the rising grounds in the immediate vicinity of the city were occupied by a division of the Swedish cavalry and infantry. Frederic remonstrated against this gross and unprovoked infraction of the treaty; but Charles would scarcely admit the ambassadors sent on this occasion into his presence. This behaviour of the Swedish monarch made the nobility determined to lay aside their animosities, and to defend their monarch to the last extremity. It was also resolved to grant the burghers of Copenhagen certain important privileges, to induce them to support their sovereign, and cheerfully to endure the rigours of a siege. Their adherence to their sovereign was rendered still closer and firmer, by the condition to which the provinces lately ceded to Sweden were reduced; they were loaded with taxes, and the inhabitants were most grievously oppressed, both by the Swedish king and nobility. Frederic on this, as on the former occasion, was animated by the intrepidity, and assisted by the prudence of his queen; and he was so clearly convinced of the justice of his cause, and of his ultimate success, that he absolutely refused to comply with the advice of his council, and retire into Holland.

The Swedes invade Zealand.

Charles was fully persuaded that Copenhagen must soon fall into his power; and this confidence rendered him dilatory and unguarded. Frederic, on the other hand, was extremely vigilant; and he profited by the delay and oversight of his opponent, to prepare every thing necessary for a long and vigorous defence. The Swedes made their first attack on Cronenberg; and this place requiring a large force, and several weeks to reduce it, the siege of Copenhagen, in the mean time, was carried on with little alacrity or advantage. As soon as this fortress was reduced, Charles pushed the siege with great vigour; but he soon perceived that the defence wonld be both long and obstinate. He next turned his plans towards the reduction of the city by famine; but while part of his fleet was cruizing for the Dutch squadron, supplies of provisions were introduced into Copenhagen. Part of this city is built upon the isle of Amak, which is peopled by the descendants of a colony from East Friesland, to whom the island was given by Christian II. at the request of his queen, the sister of Charles V. for the purpose of supplying her with vegetables, cheese, and butter. It is entirely laid out in gardens and pastures, and the produce brought to the market of Copenhagen. This island Charles resolved to get possession of if he possibly could, and he accordingly made a sudden descent upon it at the head of large body of forces; he was opposed by Frederic, who sallied out of Copenhagen, broke through the Swedish lines, threw them into confusion, and obliged Charles to throw himself into a boat, and regain his fleet. The next day the Dutch fleet that had been sent to the assistance of their allies entered the Sound: Charles immediately ordered his fleet to oppose their advance to Copenhagen, and a most dreadful battle was the consequence, which terminated in the Swedes drawing off, under the protection of the cannon of Lanskroon, and in the Dutch admiral succeeding in his purpose of landing a large supply of provisions and ammunition, as well as a considerable reinforcement of men at Copenhagen. The Swedish monarch, disappointed at the issue of this battle, was soon afterwards alarmed by the advance of the elector of Brandenburg and the other allies of

Siege of Copenhagen.

Naval battle between the Dutch and Swedes.

Frederic into Holstein, where they gained several advantages. The militia of Norway also invaded Drontheim, which, by the last treaty, had been ceded to Sweden; and the people of this province still retaining their partiality for their native sovereign, it was soon reduced. However, neither the advance and success of the Danish allies, nor the conquest of Drontheim, turned Charles aside from his designs against Copenhagen; and in 1659, having concluded a peace with the Czar, he determined to make a vigorous and general effort to gain this city, before the frost should enable the elector of Brandenberg to pass over on the ice to Zealand. On the 10th of February, his measures being taken, and his preparations complete, he commanded the city to be stormed. In order to conceal the march of his troops on the snow, he ordered them to put shirts over their clothes, and they were thus enabled to come so near the besieged, as to touch them with their arms before they were perceived. Three attacks were made, but they were all unsuccessful: the first was led on by Steinboch, but his troops having lost all their officers, became daunted and fled; the second attack, led on by Colonel Smidt, had nearly succeeded on the side of the isle of Amak, when the Colonel was slain and his troops repulsed; Bannier, one of the most celebrated of the Swedish generals, commanded the third attack, but he was taken prisoner, and his division totally defeated. Charles, on this failure, might perhaps have been reduced to raise the siege, had not an English fleet arrived in the Sound, which prevented the Dutch admiral from throwing any more succours into Copenhagen; the blockade was therefore continued, and divisions of the Swedish army were sent into Langland and Laaland, which they reduced. Soon afterwards France and England offered their mediation for a peace; but there was such a great degree of exasperation and jealousy, and such opposing views and interests, that the negociations were very protracted and intricate: while they were carrying on, a cautionary clause was agreed to by the mediators, by virtue of which the Dutch fleet was permitted to enter Copenhagen, and thus in fact the siege was raised. The English mediator, perceiving that Charles was little disposed for peace, took his departure; and the Dutch being now at liberty to act in favour of Denmark, the Danes made a descent on Funen, and defeated the Swedes there with great slaughter. But the United States, whose interest it was not to permit either of the Baltic Sovereigns greatly to preponderate over the other, refused to permit their forces to enter Zealand, and assist the Danes to drive the Swedes completely out of it. Though hostilities had not been interrupted, the negociations for peace were still carried on; and Charles, perceiving that his projects were neither supported nor countenanced by England, while Frederic had been made equally sensible of the lukewarmness of the Dutch in his behalf, the two sovereigns became more sincere in their wish for peace. But Charles, though willing to accede to fair and honourable conditions, absolutely refused to give up Drontheim, on the cession of which the Danish commissioners most pointedly and strongly insisted; the war therefore would most probably have been renewed, had not the king of Sweden died. The French and English ambassadors took advantage of this event to bring about a peace between the two countries. By the articles of this peace, the fortress of Cronenberg, all the Danish islands in the Baltic, and Drontheim in Norway, were restored to Frederic; the isle of Rugen, the provinces of Blekingen, Halland, and Schonen, were given to Sweden.

Copenhageu stormed without success.

Peace restored.

Within a very few months after peace was concluded, Frederic effected a complete change in the constitution of the government of Denmark. By his conduct during the war, he had raised himself very much in the opinion of all classes of his subjects, for his firmness and his attachment to the interests of his country. But he was particularly dear to the common people: he had placed himself, in many instances, as a barrier between them and the insolent oppression of the nobles. The circumstances of the times, too, had rendered the nobility less formidable and powerful. Commerce had begun to produce its usual effects in Denmark as well as in other countries; it had rendered power and wealth more equal, by introducing new wants and desires among the privileged classes, and the ability to gratify them among those who hitherto had not been privileged, it brought them nearer to a level. Before, however, Frederic could take advantage of this state of things, it was necessary to investigate the condition of the kingdom; and it was found truly deplorable. The army had not been paid for a considerable length of time, consequently there was much dissatisfaction among the soldiers; scarcely any of the ships of war were fit to put to sea; and the public treasure was nearly exhausted by the avarice and extravagance of the nobility. To consider and remedy these evils, an assembly of the states was convoked on the 8th of September 1660. Notwithstanding the real power of the nobility was much curtailed, they were disposed to be as presuming and overbearing as formerly; but the citizens of the great towns now began to feel their weight and importance in the state, and particularly those of Copenhagen, to whom, as a reward for their patriotic and gallant behaviour during the siege, several of the rights of nobility had been granted.

Change effected by Frederic in the constitution of Denmark.

Frederic, aware of all these circumstances, determined, during the sitting of this assembly, to reduce the power of the nobles, and to extend his own power on the ruin of theirs. In this plan he was most zealously and successfully assisted by the queen, a woman not only of great fortitude, but of uncommon talents. She brought over to the king's party and interest, the field-marshal and some other noblemen; but she principally depended on the exertions and intrigues of the bishop of Zealand, the burgomaster of Copenhagen, Gabel a German, the king's private secretary, and also secretary to the privy council, and Lenthe, who was likewise a German. The first discussion in the diet respected the raising of the necessary supplies: the nobility proposed to lay a tax upon every thing that was consumed; and as a great mark of their condescending patriotism, offered to contribute equally to this tax; but when their offer was explained, it was found in fact to amount to almost nothing. They consented to pay this tax only when they were in town, and not at all while they resided on their own estates; nor would they subject themselves to it, even with this limitation, for a longer period than three years, while they insisted that the farmers should pay it as a permanent tax, and to its full amount. When the other orders began to remonstrate against this conduct, the nobility publicly and haughtily told them, that they ought to regard and receive it as a mark of the highest condescension, that they had deviated on this occasion from their established privileges. The clergy and the representatives of the

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people were indignant at this declaration, and they immediately proposed, in order to be revenged on the nobles, that all the fiefs of the crown should be let to the highest bidder, and that all classes should be deemed capable of holding them. Before this the crown lands had been rented exclusively by the nobility, who moreover paid for them only a very slight consideration. The nobles exclaimed most loudly and violently against the proposal, but the other orders were firm; and the friends of the king perceived that the moment was arrived for raising his prerogative and power firmly and permanently above those of the nobility. In this predicament the nobles acted with the utmost imprudence,; and the violent and overbearing conduct of one of them in particular, accomplished their ruin, and brought the plan of the king to maturity. In these diets, the nobility sat in a separate apartment from the clergy and the commons; but as it was necessary in discussing the nature and amount of the taxes, that a deputation from these two orders should attend the nobles, the bishop of Zealand, another clergyman, and the deputies of Copenhagen, were desired to attend; several others of the commons accompanied them unasked and unexpected: with this one of the senators, a proud and violent man, was offended, and he commanded all to leave the hall who had not been sent for. This behaviour increased their mutual jealousy and antipathy; and the clergy and commons determined no longer to communicate their plans or wishes respecting the subjects on which the diet was convoked, to the king through the senate, as had always been the custom, but directly to the sovereign himself. Frederic perceived immediately the advantage he might derive from this resolution, and he accordingly received the deputies of the clergy and commons in the most gracious and condescending manner. The nobility still persevered in their imprudent and rash line of conduct, and farther irritated the other orders, by materially altering a tax bill which had been sent to them. The bishop of Copenhagen, who was upon the alert to serve the king, immediately proposed to his order to sign a declaration, making the crown hereditary in the royal family. This proposal was readily accepted; the declaration was signed by the clergy, sent to the representatives of the people, who as readily gave their sanction to it, and on the very same day transmitted to the speaker of the nobles to have the concurrence of that order. The nobility were now alarmed and suspicious. They perceived that it was absolutely necessary to yield some points to the king, and by this reluctant yielding, they hoped to satisfy him; they, therefore, proposed to Frederic, that the crown should be hereditary in the male line only; but as the king was acquainted with the declaration that had been passed by the clergy and commons, he rejected the proposal of the nobles. On the next day, this order found itself under the necessity of acceding to the declaration, and a committee of the three orders was appointed by the king to carry the declaratlon into effect, by giving it the form and authority of a law. When this committee met, one of the members observed, that in all countries where the crown was hereditary, fundamental laws were established; and that as Denmark now was in that predicament, the committee ought to direct their attention to the passing of the necessary fundamental laws. This observation alarmed the friends of the king, whose object and wish it was undoubtedly to crush the power of the nobility, but not to limit the prerogatives of the crown.

Disputes between Frederic and the nobility.

The deputy, therefore, who moved the observation, was informed, that his future attendance on the committee would be dispensed with. The first point that occupied the committee, respected the capitulation which the Danish kings signed when they ascended the throne. As the constitution was about to be changed, it was necessary also to alter the articles of the capitulation. All agreed that certain articles should be omitted, and that others should be materially altered; but there was much difference of opinion, respecting the substitution of new articles, so that the capitulation might still be in fact a species of contract between the king and the people, and might define and limit his power: the nobles concluded, that their peculiar interests should be specified and confirmed in the capitulation; the clergy, on the other hand, not only objected to the claims of the nobility, but put in claims of their own. In the midst of the clamorous debates to which this difference of opinion gave rise, the Bishop of Zealand suddenly proposed, that the crown should be made hereditary, without any stipulation or condition; this was agreed to, with a trifling and unimportant exception, that the right of primogeniture, and the indivisibility of the monarchy, should be guarded. The capitulation which Frederic had signed at his accession, and which limited his authority, was restored to him, and the following day all the orders took a new oath of fidelity; but the three orders did not sign a separate act, consenting that the crown should be hereditary, investing the sovereign with absolute power, and giving him the right to regulate the succession and the regency, till the 10th of January 1661: and ever after this the new constitution was not explained or sanctioned by any promulgated law, till the accession of Christian V. in 1670. It was drawn up by the Bishop of Zealand and the count Griffenfeld, and received the king's sanction on the 14th November 1665, but was kept in the royal archives till the period above mentioned. The royal law, as it is called, consists of forty articles, of which the following are the most important: The hereditary kings of Denmark are above all human laws, and in all affairs, ecclesiastical or civil, they do not acknowledge any superior judge but God alone; the king alone possesses the right to make, repeal, change, and interpret all laws, except the royal law, which is irrevocable; the king shall be deemed of age at fourteen, and from that time he shall have no master or guardian; from the æra of the royal law, the kings of Denmark, so long as any branch of the royal family shall exist, will be born such, without having any occasion for an election; he shall not be obliged to take any oath, or enter into any engagement whatsoever respecting the monarchy, seeing that, as a free and absolute sovereign, his subjects can neither impose upon him the necessity of an oath, nor prescribe any conditions to him which shall limit his authority. The princes and princesses of the blood shall not appear before any inferior judge, because the king himself is their judge in the first and last instance. The 26th article is very long and very express on the subject of absolute monarchy: it declares, that every thing which may be said and written to the advantage of an absolute and hereditary Christian king, should also be understood in the most favourable sense of the hereditary king of Denmark; and it directs all his successors "to take very particular care to defend their hereditary right and absolute dominion, and not to suffer it to be called in question upon any condition whatever;" and if any person shall obtain any thing contrary to

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the absolute and monarchical authority of the king, he shall be punished as having been guilty of the crime of high treason.

Consequences of the revolution in the government.

Many authors have contended, that, by this revolution, the people of Denmark lost their liberty; but the most superficial acquaintance with the history of this country previous to 1660, must convince us, that this opinion is entirely destitute of foundation. The people, in fact, were the slaves of the nobles; they were constantly degraded and oppressed by a number of petty tyrants. By the revolution they were freed from the power of these tyrants, though they were not raised to the rank and condition which they ought to hold in every well-regulated state. It may be a question, whether they were much benefited by the revolution, but there can be no doubt that it did not deprive them of their liberty. That the condition of the farmers was benefited is certain; for no sooner was Frederic invested with the supreme power, than he reduced the authority and humbled the pride of the nobles, by annulling several of their privileges, particularly that which gave them the power of life and death over their farmers. Many of the nobles resisted, and endeavoured to excite a rebellion; but their efforts were in vain, as the court took every opportunity to reduce their numbers and authority. In a very few years they were no longer formidable; the principal places of trust and emolument were kept from them. The laws protected the mass of the people against their oppressions, and the king exercised, with respect to them, the full authority with which the new constitution invested him.

Death of Frederic. A. D. 1670.

From the year 1660 till 1670, when Frederic died, he was almost occupied with the internal affairs of Denmark; he re-established the finances on an equitable and productive footing; gave encouragement to trade and commerce; and in a more especial manner promoted agriculture. In the midst of these wise and benevolent plans, he was carried off by a disorder, which he is supposed to have contracted during the siege of Copenhagen.

Christian ascends the throne.

The year before the death of Frederic, Christian, his oldest son, had been declared his successor at a general diet of the states. When he ascended the throne, Denmark, notwithstanding the plans of Frederic, was in a situation by no means prosperous. Most of the specie had been drawn out of the kingdom by the expences of the war, and the large subsidies granted to foreign powers; and the disputes which had arisen with Sweden, Holland, and Holstein, threatened the renewal of hostilities, and at any rate prevented the complete and regular adoption of any system of economy and retrenchment. The first object of Christian was to adjust his differences with Holstein; and this having been effected, he declared war against Sweden. Many reasons were given for this step. Sweden, ever since she was separated from Denmark, had encroached on the possessions of the latter kingdom; but a dispute respecting the Duchy of Bremen, was more particularly insisted upon by Christian, in his declaration of war. His principal allies in this war, were the Elector of Brandenburg, and the United States. With the former, the plan of the campaign of 1675 was arranged; and in conformity to it, his Danish majesty attacked and took the strong post of Damgarten, while his allies were employed in Pomerania. The next was a conjoint operation against the city of Wismar. Great and formidable obstacles here opposed themselves; but they were overcome by the perseverance and talents of Christian; finding that the marshes on which the besieging army was encamped, were unhealthy, he ordered them to be drained; and when this was proved to be impracticable, he kept his camp dry by dikes and ditches formed round it. The garrison held out with great obstinacy, and Christian at last resolved to carry it by storm; before the troops could arrive near enough for this purpose, it was necessary to march over the marshes, exposed to a galling fire from the garrison. In order to render the marshes passable, light wooden bridges were laid over them; and on these the troops proceeded three a breast. The fire to which they were exposed, at first daunted and checked them; but animated by the example of their sovereign, they proceeded, and in the space of a few hours the governor capitulated. After the reduction of this place, Christian meant to have invaded the isle of Rugen; but he was drawn aside from this scheme, in consequence of false information that the Swedes were preparing to make a descent on Zealand. In consequence of this, he returned to protect his capital. The next enterprize of Christian and his allies, was the reduction of Stade, which city fell into their possession after a long but not a very active or obstinate defence. Hitherto the fleets of the hostile powers had not met; but in the beginning of June, the Danish fleet having been reinforced by some Dutch ships, after having conquered the isle of Wisby, fell in with the Swedish fleet between the coast of Schonen and the isle of Bornholm. An action commenced, which continued, at intervals, for two days, but terminated without any advantage to either party. In this engagement the Swedes possessed the superiority in point of numbers; but a few days afterwards, the Danish admiral having been reinforced by four Danish and three Dutch men of war, under the command of the famous Von Tromp, again proceeded in quest of the Swedes. On the 11th of June, the battle began; in a very short time the Swedish admiral's ship, which is said to have carried 134 pieces of brass cannon, and 1100 men, was blown up. On this the rest of the fleet endeavoured to escape, but being surrounded by the Danish and Dutch vessels, they gave up this idea, and fought with astonishing intrepidity; but situated as they were, their intrepidity was of little avail; ten of their ships, besides some small vessels, fell into the hands of their enemy. The immediate consequence of this victory was, the reduction of Stade, which has been already noticed; and the resolution, on the part of Christian, to invade Schonen. While the Swedes were superior, or even equal to the Danes by sea, this invasion was impracticable, but now it could be easily effected, and promised to be attended with complete success. As soon as Christian entered this province, he ordered Von Tromp to attack the city of Ustadt, which, after a short but obstinate defence, was evacuated by the garrison. The Danes lost no time in following up their success, and Christianstadt, Helsingburgh, and Landscroon, were reduced. Charles the Eleventh, King of Sweden, alarmed at the progress and success of the Danes, collected a large army, surprized three thousand men under General Duncamp, and totally routed him. Christian, on the intelligence of this disaster, marched himself against the Swedes, who retreated in a rapid manner before him, so that he could not come up with them. In order to draw them on to an engagement, he laid siege to Malmo. As it was of the utmost consequence to relieve this place, Charles, at the head of 18,000 men, encamped on the opposite side of the river, which divided the two armies. He soon found, however, that the direct relief of Malmo was

Declares war against Sweden.

A. D. 1675.

Naval battle between the Danes and Swedes.

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impracticable, and therefore breaking up his encampment, he proceeded to lay siege to Helsingburgh. This brought on the battle of Lundin, which, though not decisive in its actual and immediate consequences, ultimately proved advantageous to the Swedes, by enabling them to relieve Malmo. In the mean time, negotiations were going on at Nimeguen for a general peace, and the Danish and Swedish ambassadors attended the congress there; but while the other European powers seemed disposed to reconcile their differences, Sweden and Denmark made such unfair and exorbitant claims on each other, and betrayed such a great degree of mutual jealousy and suspicion, that preparations were soon made for prosecuting the war between them with renewed vigour. The Danes resolved to make another attempt to gain possession of Malmo; but owing to the accidental breaking down of the draw-bridge, just as they hoped to attain their object, they were repulsed and compelled to raise the siege. By sea, the King of Denmark was more successful. A Swedish fleet lay at Gottenburgh, which the Danish admiral attacked with great fury, and with such success, that six of the Swedish ships were taken. The Swedes eagerly sought an opportunity to wipe away this disgrace; and learning that the same Danish admiral was lying near the isle of Mona, it was resolved to attack him with greatly superior numbers, under the command of some of the best officers in the Swedish navy. In this battle, the Danish admiral made up, by his skilful manœuvres, for his inferiority in respect to numbers. He broke the line of the enemy, and threw them into such confusion that they were not able to fight to any advantage. The consequence was, that seven of their ships were taken or destroyed. Nearly at the same time the Danish and Swedish armies met, each commanded by its king. The Swedish army was nearly double that of Denmark; but Christian was not dispirited; he fought with the utmost bravery, and his example was followed by his whole army; so that the only advantage which the Swedes gained was that of keeping the field, the Danes retreating to their camp in good order. In Norway the war was prosecuted with great vigour, and with various success, though on the whole the Danes gained more brilliant, as well as more substantial, advantages than their opponents. In Pomerania they were not so successful. After Count Konigsmark had been compelled to abandon Rugen, he retired with his army to the neighbourhood of Stralsund: here he meditated the reconquest of the isle, and for this purpose requested and obtained the assistance of the burghers of Stralsund. The Danish governor, not supposing that Konigsmark was in a condition to act on the offensive, was careless and unguarded, and did not even dispute his landing on the island: as soon as he was landed, he marched against the Danish army, which was encamped at a distance from the shore. At the very commencement of the battle, the Danish governor was slain; disputes arose among the inferior officers, subordination was destroyed, confusion took place, and though part of the Danish forces broke through the left wing of the Swedes, they were compelled to retreat, and 5000 men were made prisoners. While his general was thus victorious in Pomerania, the Swedish monarch was actively employed in besieging Christianstadt. Christian marched to the relief of this place, at the head of 12,000 men, but all his attempts were frustrated; he could not expect to succeed unless he defeated the Swedes; and they, strongly intrenched, would not quit their camp; Christianstadt, therefore, was forced to surrender in sight of the Danish army.

Battle of Lundin.

Naval battles.

As some compensation for the loss of this place, the Danish admiral planned a descent on the isle of Rugen, and succeeded in retaking it, and in reducing Stralsund and some other places in Pomerania. Soon afterwards, the negociations at Nimeguen were resumed; and Christian, being forsaken by his allies the Dutch and the Elector of Brandenburg, ordered his minister to sign a peace with Sweden, in the month of September 1679. By this peace, the King of Sweden obtained all that he claimed before the war, and Christian was obliged to submit to those terms which were dictated by France, in consequence of the defection of his allies. Holstein Gottorp was restored to its Duke; and the treaties of Roschild, Copenhagen, and Westphalia, were declared in force between the courts of Denmark and Holstein. While the negociation was pending, Christian marched a large army into the neighbourhood of Hamburgh, under the pretence of disputing the passage of the Elbe with the French general, who was advancing to support the Swedes. The people of Hamburgh were alarmed, and suspecting Christian's designs to be hostile to them, they fortified their city. Christian, upon this, avowed his purpose in a manifesto, in which he laid claim to Hamburgh: and immediately laid siege to it; but Louis the Fourteenth interfering, and the Duke of Brunswick having sent a body of troops to defend the city, a treaty was concluded, by which Christian renounced his claims, on the payment of a certain sum of money. In 1680, the hostility which had so long existed between Sweden and Denmark, and which, even during peace, had frequently manifested itself, by mutual jealousy, was for a time suspended, by the marriage of Eleonora, princess of Denmark, with his Swedish majesty. Christian, still having views on the city of Hamburgh, learned, with much satisfaction, that the senate and the people were at variance, in consequence of the latter having refused to pay the taxes laid on by the former. The disputes ran so high, that all government ceased; and no opposition to Christian's schemes seemed likely to arise. He therefore advanced with a powerful army; but his presence and threats united the senate and the people. His proposals were rejected, his attacks repulsed, and he was obliged to desist from his designs against this city. Few events of importance occurred from this time till the death of Christian. He took advantage of the expiration of the treaty of commerce between Denmark and Holland, to raise the Sound dues; this was opposed by the Dutch, and Christian was obliged to yield. In 1689, a treaty was concluded at Altona, by which he consented to confirm Duke Albert in possession of Sleswick and Holstein, of both of which he had defrauded him some time before. In 1699 Christian died, in the 54th year of his age, and 29th of his reign.

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Peace concluded. A. D. 1679.

A. D. 1680.

Death of Christian. A. D. 1699.

Christian was succeeded by Frederic the Fourth. This prince was tempted, by the extreme youth of Charles the Twelfth, King of Sweden, to commence hostilities against that monarch; but as he had no direct ground for a war with Sweden, he renewed his claims to Holstein, the duke of which had married the sister of Charles the Twelfth. Accordingly he invaded this province, and laid siege to Tonningen. Charles lost no time in assisting his relation; he sent 8000 men into Holstein, and, at the same time, he himself, at the head of 20,000 men, landed in Zealand, and laid siege to Copenhagen. The inhabitants,

Frederic IV. ascends the throne.

History.

War with Sweden.

in the absence of their sovereign, sent deputies to Charles, to request that he would not bombard the town; to this request he gave his consent, on condition that they paid him immediately about 80,000 pounds, and brought regularly to his camp all kinds of provisions, for which, however, he engaged to pay punctually. As soon as Frederic learned that his capital was in such imminent danger, he published an edict, in which he promised freedom to all those in every part of his dominions that should take up arms against the Swedes. Charles, upon this, informed his Danish majesty, that he only made war to oblige him to make peace; and that he must resolve to do justice to the duke of Holstein, or to see Copenhagen destroyed, and his kingdom laid waste by fire and sword. Frederic eagerly accepted the conditions, and the peace of Travendahl was concluded, by which the full right and sovereignty was confirmed to the duke of Holstein. His Danish majesty agreed to pay him 260,000 crowns; and liberty was given to the chapter of Lubeck, to elect, as their bishop, a prince of Holstein.

While Charles the Twelfth was victorious, this treaty was faithfully observed by Frederic; but fortune having deserted the former monarch, and the duke of Holstein having been killed in 1702, Frederic again invaded this province. Steinboch, one of Charles's best generals, had thrown himself into Tonningen, and Frederic made this a pretext for the renewal of hostilities, and the whole province was occupied by his

A. D. 1720. troops. In 1720, however, he entered into a treaty with the young duke Charles Frederic, by which he kept the whole of Sleswick, and restored only part of Holstein. The reverses of the king of Sweden also prompted Frederic to invade Schonen: At this period Sweden was in a state of great disorder; the senate, and the regency whom the king had established when he left Stockholm, were at variance; but as soon as they heard that their country was invaded by the Danes, all their animosity and disputes were forgotten. There were only 8000 regular troops in the kingdom; to these Steinboch united about 12,000 militia, and came up with the Danes, who were ravaging the country in a most barbarous manner, near Helsinburgh. He did not intend to have attacked them immediately, but his militia were so eager to engage, that he altered his plan; and two regiments of those farmers, who had only taken up arms three weeks before, fought with so much intrepidity, that they destroyed nearly all the king of Denmark's guards, so that scarcely ten of them escaped. The Danish army was entirely defeated, and retired under the cannon of Helsinburgh. A few days after this disastrous battle, the remains of this army quitted Sweden with great precipitation, killing all their horses, setting fire to their provisions and baggage, and leaving 4000 wounded in the town, all of whom died for want of food, the Danes having laid

A. D. 1711. waste the country round Helsinburgh. In 1711, Frederic invaded Swedish Pomerania; but though he was assisted by the Poles, he gained little advantage by this invasion, except the reduction of Damgarten. In the following year, he conquered the duchy of Bremen, and took the city of Stade; but the Swedish army advancing against him, he was defeated with considerable loss, and the town of Altona burnt to the ground. The Swedes afterwards having invaded Norway, Frederic proceeded to the defence of that part of his dominions, and compelled them to retreat with great loss. Charles the Twelfth was still absent from his country; and the allied powers, Poland, Prussia, Denmark, and George the First as elector of Hanover, attacked the Swedish possessions on the east side of the Baltic; the reduction of Wismar was entrusted to Frederic, and he succeeded in effecting it. Soon after Charles returned to Sweden, he raised and disciplined a large army; with which, though his own country was threatened on all sides with powerful and victorious enemies, he suddenly invaded Norway. In this kingdom there were only 11,000 troops; so that Charles soon made himself master of the greatest part of it: He had advanced near to Christiana, but as he had taken no precaution for the support of his army, he was obliged, from want of provisions, to retire into Sweden. In the

A. D. 1718. month of October 1718, Norway was again invaded by Charles; but the kingdom was saved by the death of that monarch at the siege of Fredericshall, on the 11th of December; upon which the Swedish army returned into their own country. The war between the two powers continued with various success, but presenting no event of importance till 1720, when peace was concluded, under the mediation of George the First. The principal article in this treaty secured the possession of the duchy of Sleswick to Denmark, under the guarantee of France. Between this period and 1730, when Frederic died, the kingdom was tranquil and flourishing: The only circumstances which impeded its advancement in prosperity, were the destruction of a great part of the capital by fire, and the disposition of Frederic to lay out the public money on impracticable or unprofitable schemes.

Peace concluded. A. D. 1720.

Christian VI. ascends the throne.

Christian Frederic, better known under the appellation of Christian the Sixth, succeeded his father Frederic the Fourth. During nearly the whole of his reign, Denmark enjoyed a state of profound peace; and Christian took advantage of this circumstance to improve his territories and benefit his subjects: hence no sovereign is a greater favourite with the Danish people. Several monopolies existed, some of which were extremely prejudicial and obnoxious to the nation at large; these he either totally abolished, or regulated and restrained in such a manner, as to diminish and limit their evil consequences. In particular, he abolished a farm, which he had established during the reign of his father, among his other speculations, for the exclusive sale of brandy, wine, salt, and tobacco. In the abolition of this farm, he displayed not only his wise and comprehensive policy, and his regard for the interests of his people, but also that exclusive or paramount regard to their interests, which too seldom is found to actuate the conduct of princes; for this monopoly was not more oppresive to his subjects, than it was lucrative to himself. When the persons to whom this monopoly had been granted, offered to give him large sums of money, provided he would permit it to be continued, he replied, "It produces too much, since my subjects complain of the exactions it occasions."

His regulations in favour of trade and commerce.

The disputes which had so long subsisted between Hamburgh and Denmark, and which more than once had broken out into bitter and rancorous hostility, were brought to a complete and advantageous termination by Christian; he indeed managed this business with so much adroitness, as to induce the people of Hamburgh to consent to pay him a large sum of money, and to grant several privileges which were highly beneficial to the trade and commerce of his subjects. But his attention and thoughts were in a more especial manner directed to render his country powerful, rich, and happy; in order to effect this, he established a council of trade, composed of men whose experience

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and information rendered them most fit and proper for this situation; their duty was carefully to examine every proposal made for the extension of commerce; to suggest, of themselves, whatever they thought would benefit it; and to give the necessary encouragement to such plans as met with their approval. Into some of his schemes for the extension of trade and commerce, we may perhaps perceive that error to have crept, which is too often committed by sovereigns and statesmen; he thought that his own country ought and might supply itself with every thing; or at least that it would be better to produce what was necessary or wanted at home, though at a greater expence, than import it from foreign countries. The royal bank of Copenhagen owes its origin and establishment to him; and from it trade derived many advantages, by the facility which it afforded of raising and disposing of money. The army and navy were not neglected: in order that he might be enabled to put them on a respectable footing, without oppressing his subjects with taxes, he entered into subsidiary treaties with foreign powers. In rebuilding Copenhagen, he paid particular attention to the convenience and healthiness of the place; and the royal palace was rebuilt in a style of elegance, which displays considerable taste in architecture.

During the whole of his reign, he had only two disputes with foreign powers; one with the king of Great Britain, as elector of Hanover, in 1738, respecting the lordship of Steinhorst, in which some blood was spilt; but Christian carried his point so far, as to receive a subsidy of L.70,000 a year from Great Britain, on condition that Denmark kept 7000 troops on foot for the protection of Hanover. The other dispute in which he was engaged, respected the Iceland fishery, to which the Dutch made some claims, which Christian thought unfounded; this also terminated to his advantage and honour; and in both cases, he discovered great firmness united with moderation, and a degree of policy and prudence, which enabled and disposed him to conduct the dispute in such a manner, as insured such a result as he desired. He died in 1746, after a happy and prosperous reign of sixteen years, and was succeeded by his son Frederic the Fifth.

Death of Christian. A. D. 1746.

Frederic V. ascends the throne.

In 1743, Frederic had married Louisa, daughter of George the Second. He was very fortunate in two of his ministers, Count Bernstoff, and Count Schimmellman, both noblemen of very superior talents and information, and anxious to employ them for the benefit of their sovereign and his subjects. Under their guidance, Frederic applied himself to carry on the plans which his father had begun, and by the assistance of the latter nobleman, more particularly, the finances of Denmark were completely restored to order, and the taxes were rendered lucrative, without being burdensome or oppressive to the people. One of his first objects was the regulation of his domestic economy, which indeed had been begun by Christian: into it he introduced much retrenchment, and established it in such a manner, as secured order and method, and enabled him to detect and put a stop to any extravagance, or unfaithfulness, on the part of his household. At first his subjects were rather apprehensive that this minute and scrupulous attention to his domestic economy proceeded from, and indicated a narrow and parsimonious disposition, but they were soon convinced that their welfare alone was his motive and object; he was saving and economical himself, in order to render their condition more comfortable. That he was not mean or avaricious, was most clearly and honourably shewn by his behaviour, when a great mortality happened among the cattle, on some of the crown estates; he immediately, and unsolicited, remitted his just rights; and whenever famine oppressed or threatened his people, he stepped forth to their relief. By the order and economy which were introduced into the finances, he was enabled, not only to encourage trade and manufactures, and to keep his fleets and armies on a respectable footing, but also to pay off a considerable part of the debt which had been contracted by his predecessors. An anecdote is told of Frederic on this occasion, which deserves insertion, as displaying his character to great advantage. When the creditors of the crown learned that he had determined to pay off the debt, they endeavoured to dissuade him from his purpose, by promising to lower the interest from 5 to 4 per cent.; to this the king replied, that as he had money in his coffers, where it could be of no use, he preferred paying off the public debt; but he should esteem it a personal favour if they would lend the money to his subjects at the interest at which they had offered it to him.

Frederic, like his father, was of a pacific disposition, and he conducted himself with so much prudence, as to keep clear of the seven years war, in which almost all the powers of Europe were entangled. His connection with the king of England, however, led him to offer his mediation, when the Duke of Cumberland was unsuccessful: and it was through that mediation that the treaty of Closterseven was agreed upon. The end of his reign was not so fortunate as the beginning of it: Peter Ulric of Holstein had ascended the throne of Russia; and soon afterwards laid claim to the whole of that province, and also to the Duchy of Sleswick. Frederic, alarmed at the prospect of a war with Russia, was persuaded to employ a French officer, for the purpose of introducing the new tactics into the Danish army: the Danish soldiers were strongly averse to any change, and more especially averse to it, if introduced or recommended by a foreigner; the French officer, with that vanity, rashness, and presumption so common among his countrymen, paid no attention to the murmurs, or even to the expressed discontent of the soldiers: he still proceeded with his reforms, till the safety of the kingdom absolutely required his removal, and the restoration of the established discipline. While these things were going on, a Russian army, under General Romanzow, entered Holstein, and it is probable that this province would have been wrested from Denmark, had not the Emperor Peter been suddenly taken off: Catherine, who succeeded him, immediately recalled her troops, and a negociation was entered into, respecting the exchange of part of Holstein for Oldenburgh and Delmenhorst, but it was not completed when Frederic died, on the 14th of January 1766.

Death of Frederic. A. D. 1766.

Christian VII. ascends the throne.

The commencement of the reign of his son Christian VII. was auspicious; all the peasants on the crown lands, who hitherto had been in a state of most abject vassalage, were emancipated by the first edict which he issued. The negociation with Russia respecting Holstein was resumed, but it could not be finally adjusted, till Paul Petrowitz, who was heir to the German possessions of Peter, attained his majority. This event did not happen till the year 1773, when a treaty was signed, by which the counties of Oldenburgh and Delmenhorst were ceded to the grand duke of Russia, and the king of Denmark, as a compensation, was put in possession of the whole of Holstein.

Frederic V. after the death of his first wife, by

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whom he had Christian VII. married a daughter of the duke of Brunswick Wolfenbuttel; this princess was of an ambitious disposition, and was not restrained by any sense of justice, or feeling of moderation, from pursuing those measures to which her ambition prompted her. She had by her husband a son named Frederic, and her most anxious wish was to place him on the throne, after the demise of Christian; but Christian had married Matilda, the youngest sister to George III. and as issue was likely to proceed from the marriage, the Queen-dowager was afraid that her favourite scheme would be defeated. She, therefore, in the beginning of January 1772, formed, along with her son, a strong party at Copenhagen, who commenced their intrigues, by endeavouring to create dislike and mistrust between the king and queen. Their first plan seems to have been to have infused into the mind of the queen a disgust of her consort; and, for this purpose, the king, who was a man of a very weak mind, was surrounded by persons who kept him in a constant state of debauchery, and who took care that the queen should be perfectly acquainted with his behaviour. Matilda, however, either suspecting their designs, or indifferent about the manner in which the king conducted himself, paid no attention to their representations. The queen-dowager perceiving that the scheme they had hitherto pursued would not answer, determined to excite the suspicion and jealousy of the king against his spouse; and the unguarded behaviour of Matilda unfortunately afforded her the opportunity she wished for. She manifested an improper partiality for count Struensee: this nobleman had been originally a German physician, who, having ingratiated himself into the favour of Frederic, had been raised to the dignity of a count, and appointed his prime minister. He had neither talent, strength of mind, nor prudence sufficient to conduct himself properly in his new situation, but alarmed and disgusted the old nobility, by the unnecessary and injudicious reforms which he attempted to introduce. To this unpopular and weak man Matilda discovered an evident partiality; and on this circumstance the queen-dowager built her plans. The king was persuaded that his consort, in conjunction with Struensee and his friend count Brandt, had formed a design to set him aside, on the pretext of incapacity, and of course, according to the royal law of 1660, to declare the queen-consort regent during the minority of his successor; they suggested to him the absolute necessity of immediately signing an order for confining the queen and her associates in separate prisons; but they met with much opposition and reluctance. It was, therefore, advisable to conduct this part of the business with more caution, and to wait for a favourable opportunity of still farther exciting the suspicion and jealousy of the king against his consort and Struensee. This opportunity offered itself on the 16th of January. On the evening of that day, a masked ball was given at court, from which Matilda, after having danced the greatest part of the night with Struensee, retired about two o'clock in the morning. The queen-dowager and prince Frederic, who had undertaken to surprise the king and make him sign the order, entered his apartment soon after Matilda had left the ball room, waked his majesty out of his sleep, and told him that his consort and the count Struensee and Brandt, were at that very moment drawing up the act of renunciation, which they would compel him to sign; and that if he wished to save himself, he must give instant orders for their arrest. Frederic still hesitated, till they actually threatened him into compliance. The queen-consort was immediately taken out of bed, and with her infant princess conveyed to the castle of Cronenberg, while counts Struensee and Brandt were confined in separate dungeons, and treated with the utmost severity. An extraordinary commission was appointed to try the supposed criminals. The queen was accused of a criminal conversation with Struensee; and this nobleman was accused of having abused his authority, and of having applied a great part of the public money to his private emolument; but no witnesses were found to substantiate either of these charges, or the more heinous charge of having had designs to deprive the king of his authority. The queen-dowager, however, resolved to proceed; and though, by the laws of Denmark, the torture was forbidden to be used for the purpose of extorting confession, yet Struensee was threatened with it, unless he confessed every thing that was demanded of him respecting the queen. The fear of the rack produced from him the confession which the queen-dowager wanted; he acknowledged that he had been intimate with the queen. Struensee and his friend Brandt, after having been under examination nearly two months, at last received sentence: the sentence of the former states, that he had confessed himself guilty of a crime, which comprehended the crime of treason in the highest degree; and that he had defrauded the king, and applied the public money to his own use. The last accusation they had not been able to substantiate by witnesses, nor had Struensee acknowledged its truth; but by obtaining possession of his private papers, it appeared that he had made a charge of 120,000 rix dollars for an article of expence, which could not amount to 20,000 rix dollars. When Struensee was examined on this head, he acknowledged that the papers were in his hand-writing, but that this charge, as well as several others, had been falsified by some other person. The sentence of Brandt accused him of having given the king a blow, and otherwise ill treating him. They were both condemned to be beheaded, after having their right hands cut off: the sentence was carried into execution on the 28th of April 1772. The English court interfered in behalf of the queen consort; and she was liberated from her confinement, and permitted to spend the remainder of her life at Zell, in Hanover. The queen-dowager having thus accomplished part of her object, by means, however, which excited great indignation, placed about the king count Guldberg, one of her associates. In order to draw off the public thoughts from the recent transactions, this minister passed several laws much in favour of the great body of the people, particularly one law which gave to the natives of Denmark very special privileges, and which was declared to be a fundamental law of the kingdom.

Intrigues of the Queen-dowager. A. D. 1772.

Execution of Struensee and Brandt, A. D. 1772.

In 1780, Denmark, persuaded or intimidated by the empress Catherine, joined the armed neutrality of the North. From this time till the year 1784, nothing remarkable happened; the king's imbecility of mind grew every day more apparent, and intrigues were set on foot to take advantage of it. The king of Prussia, who was nearly related to the queen-dowager, by her means, gained an almost absolute sway in the cabinet of Denmark; the only minister who opposed his views was count Bernstoff, and he was soon dismissed from his employments, and obliged to retire into Germany. But in order still farther to strengthen his party, it was

Denmark joins the armed neutrality of the North, A. D. 1780.

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necessary to keep the prince royal out of the privy council. By the laws of Denmark, he could not be sworn in a member till he had taken the sacrament, and he could not take the sacrament till he had undergone a public examination; this the ruling party contrived to put off, under the pretext that he was not yet sufficiently well instructed in religion. As soon, however, as he arrived at the age of 16, they were obliged to consent to his admission into the privy council; and the first step he took was to advise the king to dismiss his ministers, and to reinstate count Bernstoff. The other party endeavoured to intimidate him; but he was resolute, and carried his point. A new council was formed; and as they apprehended that the queen-dowager might again take advantage of the king's imbecility, they passed an order, that no instrument signed by him should be valid, unless it were countersigned by the prince. One of the first acts of his administration rendered him extremely popular; he completely emancipated all the peasants on the estates of the crown, with so much prudent and cautious preparation, that no evil consequences resulted from this change on their condition. His example was followed by some of the nobility, but by no means to the extent that he wished or expected. The slave trade was also abolished, principally by the advice and exertion of count Schimmellman, who himself possessed large estates in the West Indies.

Denmark joins the northern confederacy against Britain, A. D. 1801.

For a considerable time after the commencement of the French revolution, Denmark remained tranquil, wisely refusing to engage in the wars produced by that event. At length in 1801, the madness of the emperor Paul obliged her to accede to the confederacy against Great Britain, formed by Russia and Sweden. In consequence of this, Great Britain sent a formidable fleet into the Baltic, the transactions of which against Copenhagen have been already fully detailed in the article Britain. The defeat of the Danes, and the death of Paul, dissolved the confederacy; and the Danish possessions in the East and West Indies, of which the British had captured, were restored. When the war between Britain and France recommenced in 1803, Denmark resolved, if possible, to adhere strictly to her system of neutrality; but it was soon apparent that the success of the latter power in Germany would place her in a perilous situation, or compel her to take an active part in the contest. But she escaped till the year 1807, when the peace of Tilsit convinced the British cabinet, that Denmark, even if she were well disposed to resist the importunities of France to unite herself against England, was no longer capable of acting as an independent power; they also knew that France was determined to gain possession of the Danish fleet, either by intrigue or force. These considerations induced them to propose to the Crown Prince to surrender the Danish navy into the hands of Great Britain, to be restored at a general peace; this proposal the Crown Prince indignantly rejected, declaring that he was both disposed and able to maintain his neutrality, and to defend his kingdom against any power that durst attack it. The British ministry, having failed in the negociation, resolved to have recourse to force. A strong expedition was accordingly sent out against Copenhagen in the month of August 1807: the operations and result of this expedition are given in the History of Britain. After the British ministry had gained their object, they endeavoured to conciliate the Crown Prince; but he was so exasperated at the bombardment of his capital and the seizure of his fleet, that he would listen to no terms, but declared war against Great Britain, and soon afterwards against Sweden as the ally of Britain. By this conduct he threw himself completely into the arms of France; and in March 1808, Marshall Bernadotte arrived in Zealand for the purpose of organising the Danish army, and concerting measures for the defence of the island, and for the invasion of Sweden. Soon after his arrival, Christian VII. died, and the Crown Prince was proclaimed king by the name of Frederic VI.

Expedition against Copenhagen, A. D. 1807.

Death of Christian VII.

The determination of Denmark to unite herself with France, gave satisfaction to Bonaparte on several accounts; it afforded him a pretext for sending a large army into Zealand, and the other Danish islands, and the probable means of transporting it to Sweden: could he effect this latter object, he would have possession of the Sound, and consequently could shut out Great Britain from the Baltic. He, therefore, encouraged Frederic in his hostile intentions against Sweden; and nearly 30,000 troops, Spanish, French, and Dutch, were assembled in Zealand; but owing to the watchfulness of a strong English squadron, the invasion could not be attempted. In the mean time, Sweden invaded Norway; but the obstacles presented by nature, and the determined resistance made by the Norwegian militia, and a few regular Danish troops, prevented them from succeeding in this enterprise. Hostilities between Great Britain and Denmark were carried on with great rancour, though on a small scale; there were frequent engagements in the Baltic and on the coasts of Norway, with the Danish gun boats and the British cruisers, in all of which the former fought bravely, and in some of which they were victorious. In the East and West Indies, Denmark was deprived of her possessions; and the small isle of Heligoland, at the mouth of the Elbe, was occupied by the British. The principal object in reducing this island was to make it a depot for manufactures and colonial produce, which might thence be easily introduced into the continent, in spite of Bonaparte's decrees and precautions against British commerce. A similar reason induced the British ministry to take possession of the isle of Anholt in the Baltic: the loss of this island irritated the Danish government so much, that they resolved to attempt its recapture. For this purpose, in March 1811, a large armament, consisting of 3000 men and 12 gun-boats, was equipped. The garrison of Anholt amounted only to about 400 men, under the command of Captain Maurice of the navy. The British commander, apprised of the meditated attack, took his precautions with a great deal of judgment; he intended to have opposed the landing of the Danes, but this they effected before he was aware, being favoured by a thick fog. As soon as they were landed, they attempted to outflank the British, or, by threatening it, to compel them to fall back into the fort: in this they totally failed, and being at the same time attacked by some British cruisers, they were obliged to retreat with great loss. Part of the Danish army had advanced against the fort, and even gained the outworks, but they also were repulsed, and their commander killed. This event threw them into confusion, by which Captain Maurice profited, and upwards of 400 of them were made prisoners. As this was a larger number than the whole of the garrison, Captain Maurice was under the necessity of permitting the rest of the Danes to reimbark.

The isle of Anholt taken by the British, A. D. 1811.

But the injury inflicted by Great Britain on Denmark was much more serious and extensive than that which resulted from the capture of her islands; her

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Annihilation of Danish commerce.

commerce was nearly annihilated, her finances were in a state of confusion and embarrassment, and Norway, cut off by the British cruisers from the possibility of gaining her necessary and usual supplies from Denmark, suffered under a scarcity approaching to famine. Still the remembrance of the bombardment of Copenhagen, but more especially the dread of Bonaparte, kept the Danish government back from offering, or acceding to, any reconciliation with Great Britain. Such was the state of things when Bonaparte lost nearly the whole of his army in Russia: he was considered as no longer formidable; and Denmark seemed disposed to profit by this circumstance to make peace with England. To this she was probably induced by another consideration; Sweden, her ancient rival, was in alliance with England, and she justly apprehended that this alliance boded her no good. An ambassador was therefore sent over to the court of St James, but without success, as the terms of the alliance between that court and Sweden, by which Norway had been in a manner guaranteed to the latter power, were incompatible with a reconciliation between England and Denmark. That the Danish government were anxious for this reconciliation, they sufficiently manifested by protecting Hamburgh against the French, with whom they were still in alliance; on the failure, however, of their mission to the British court, they withdrew their protection from Hamburgh, and united their forces to those of France.

After the reduction of Hamburgh by Marshal Davoust, the Danish forces, which were attached to his army, were inactive for some weeks, in consequence of the armistice which had been concluded between France and the allied powers. But on the recommencement of hostilities, in the middle of August, Davoust, with the Danes, marched into Mecklenburg. The object of his movements and operations, was to assist the French corps under Oudinot, in their attack on Berlin, which was protected by the Crown Prince. The advance of Davoust, however, was very slow and difficult; the allied troops in Mecklenburg, under the command of Count Walmoden, being able to check and retard his progress. With them he had several skirmishes, in which the Danes fought with great bravery, and suffered considerably.

It is probable that Davoust might have succeeded in uniting his forces with those of Oudinot; but the latter having been defeated by the Crown Prince, and Marshall Ney, who, after this defeat, was sent by Bonaparte to take the command of Oudinot's corps, having suffered a still more decisive defeat by the Crown Prince at the battle of Juterbock, Davoust thought it prudent to retrace his steps towards Hamburgh.

The important battle of Leipsic, on the 19th of October, rendered it absolutely necessary for Davoust to consult the safety of the army under his command; and he accordingly took up a strong position on the Steignitz. The Crown Prince having liberated Hanover, marched against him, in order to recover Hamburgh, and if possible to detach the Danish troops from him, and compel or persuade the King of Denmark to make peace. He succeeded, without much difficulty, in dislodging Davoust from the Steignitz. No place of refuge now remained for him but Hamburgh; and into this city he threw himself and the French division of his army, leaving the right wing of the Danes entirely exposed to the attack of the Crown Prince. Thus forsaken, they were attacked and defeated in two actions, in the beginning of December, by Count Walmoden, and the Swedish troops. In one of these actions, the most desperate bravery was displayed by two Jutland regiments. They had suffered considerably during the campaign in Mecklenburg; and in consequence of their losses, they had taken an oath to support each other, and neither to give nor receive quarter in any subsequent battle in which they might be engaged. This agreement, they most inviolably kept; rushing on the allies with indescribable fury, not more than 400 of them escaped.

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Armistice, A. D. 1813.

Nothing now opposed the Crown Prince in his conquest of Danish Holstein, which he overran in the course of a few days, the Danes retiring behind the Eyder. On the 15th of December, the Prince of Hesse, who commanded the Danish troops, proposed an armistice, which was agreed to by the Crown Prince. By the terms of this armistice, the whole of Holstein, and that part of Sleswick which borders on the Eyder, were to remain in possession of the allies; and the Danish army, which had taken refuge in Rendsburgh, was to be unmolested, but to receive provisions only through the country occupied by the allied troops, and not to add to or strengthen the fortifications of the place.

Renewal of hostilities, A. D. 1814.

The Danish government and the Crown Prince not being able to adjust the terms of peace, hostilities recommenced on the 5th of January, 1814. The first success of the allies consisted in the reduction of Gluckstadt; this was immediately followed by the advance of part of the Crown Princes' army, under the command of General Tettenborn, into Sleswick; and as the Danes were totally incapable of opposing any resistance, he soon overran the whole of Sleswick, and fixed his head quarters, on the 14th of January, at Colding, the frontier town of Jutland.

Peace concluded with Great Britain and Sweden.

The king of Denmark at last consented to the terms of peace proposed by the Crown Prince and great Britain; and accordingly, on the 14th of January, at Kiel, the British and Swedish minister signed treaties of peace with the plenipotentiary of the King of Denmark; the terms of which were, 1st, That Denmark should cede Norway to Sweden. 2d, That in return, Sweden should give up Swedish Pomerania to Denmark. 3d, That Stralsund should be a depot for British goods. 4th, That Great Britain should restore all she had conquered from Denmark, except Heligoland. 5th, That Denmark should join the allies with 10,000 men, on condition of receiving a subsidy of L.400,000 from Great Britain for the service of the year 1814. 6th, That the Danish government should abolish the slave trade. And, lastly, That Sweden and Great Britain should use their endeavours to bring about a peace between Denmark and the rest of the allied powers.

See Mallet's *Northern Antiquities* translated by Dr Percy; *Histoire de Dannemarc, par Mallet*; *History of Denmark* by the Baron de Holberg; *Suaningii Chronic. Reg. Dan. Pontani Hist. Dan. Saxo Grammaticus*; *Meursii Hist. Dan.* especially with the notes of Gramm; *Modern Universal History*, vol. xxxii.; Williams *on the rise, progress, and present state of the Northern Governments*; Lord Molesworth's *Account of Denmark*; Coxe's *Travels*, vol. v. See also the articles BRITAIN, FRANCE, and SWEDEN. (W. S.)

Part II. STATISTICS OF DENMARK.

CHAP. I.

General Geography.

Statistics. Extent.

The territories of the crown of Denmark are of great extent, and consist of several distinct, and formerly independent, principalities. Exclusive of the islands, they stretch from the river Elbe on the south, to the northern extremity of Europe and the shores of the Frozen Ocean, a length of 1400 English miles, by a medial breadth of 150. The dominions of the King of Denmark are as follow:—1st, *Denmark*, properly so called. 2d, The kingdom of *Norway*, including Danish Lapland. It is situated to the north of Denmark, and separated from it by the Categate. On the west and north it is bounded by the Northern Ocean, and on the east it is divided from Sweden by a ridge of barren mountains. 3d, *Iceland*, an island of great celebrity, and of considerable extent, in the Northern Sea, about 400 miles west from the coast of Norway. 4th, The *Faroe Isles*, lying south-west from Iceland, and about seventeen in number. 5th, *Greenland*. And, 6th, The colonies of Tranquebar, on the coast of Coromandel in India, and of Christiansburgh on the coast of Guinea, with the islands St Jan, St Thomas, and St Croix in the West Indies. A full description of the first of these divisions only, viz. Denmark, belongs to the present article. A more particular account of the others will be found under the articles Faroe, Greenland, Iceland, Lapland, Norway, &c.; and we trust our readers will be gratified to learn, that the articles Faroe and Iceland, have been written by Sir George Mackenzie, Bart. the most recent and intelligent traveller that has visited these islands; and the article Greenland, by Mr Giesecke, who resided there more than seven years, and who has been recently appointed Professor of Mineralogy to the Dublin Society.

Divisions.

Under the present article, we comprehend all the Danish dominions south of Norway, thus including the Duchies of Sleswick and Holstein. It is situated between the 53° and 58° of north latitude, and the 8° and 13° of east longitude, extending 260 miles in length, and 180 in breadth. It is bounded on the north by the entrance of the Baltic, on the west by the German Sea, on the south by the river Elbe and part of Germany, and is divided from Sweden on the east by that part of the Baltic called the Sound. This province, which, though by no means the largest, is, in a political view at least, by far the most important portion of the Danish monarchy; is composed of the Danish islands situated in the Baltic, and of the adjacent Peninsula, consisting of Jutland, and the Duchies of Sleswick and Holstein. 1st, The islands situated in the Baltic, which were the ancient and are also the present seats of Danish power, are, according to their extent and importance, as follow:—*Zealand*, which is the seat of government, and contains the capital of all the Danish dominions. It is of a circular form, and measures about 200 miles in circumference. The next in consideration is *Funen*, or *Fioma*, which is separated from Zealand on the west by the Great Belt, a strait of about 20 miles over. It is about 50 miles in length, and 40 in breadth. *Laaland*, a small but fertile island south of Zealand, 30 miles long, and 20 broad. *Langland*, to the west of Laaland, which takes its name from the figure of the island; its length being upwards of 30 miles, and its breadth scarcely eight. *Falstria*, or *Falster*, about 20 miles long, and 16 broad. *Bornholm*, the subject of frequent disputes between Sweden and Denmark, about 21 miles in length, and in breadth 13. To these may be added several others, as Mona, Samsoe, Arroe, Anholt, Lessaw, Amak, &c. 2d, *Jutland*, which is the name given to the most extensive and northern division of the Peninsula, formed by the German Sea and the Baltic. It is bounded on the south by Sleswick. It is about 180 miles in length by 98 in breadth. From north to south it is divided into the provinces of Aalburg, Wiburg, Aarhusen, and Ripen. 3d, *The Duchy of Sleswick*, or *South Jutland*, occupies the middle of the Peninsula, having Jutland on the north, and Holstein on the south. Its length is upwards of 60 miles, and its breadth 48 miles. 4th, *The Duchy of Holstein*, including within its limits Stormar, Dithmarsh, Wagerland, &c. has for its boundaries on the south, the river Elbe, the country of Lauenburg, and the territory of Hamburgh. This Duchy extends about 100 miles in length from east to west, and nearly as much from north to south.

Mountains.

While Norway abounds in lofty mountains, in Denmark there are no heights which deserve that name. The most considerable hills seldom rise above a few hundred feet, though, from the great extent of plain which they command, they are often very striking.

Rivers.

In Denmark, the rivulets are numerous, but, as might be expected from its circumscribed situation, there is scarcely a river of any note, or which is navigable for ships of burden, except the Eydar, which forms the boundary between Sleswick and Holstein, and after a course of about 50 miles falls into the German Sea at Frederickstadt. By means of this river and the canal of Kiel, a junction has been effected between the North Sea and the Baltic. Of this canal, a fuller description will be found under the head *Commerce*, in a subsequent part of this article. In Jutland is the river Gude, which has a course of about 40 miles, and falls into the Categate. In Sleswick, besides the Eydar already mentioned, are the Heveren, the Trenen, and the Hips, and also the Colding and Skodborg, which form the limits between this duchy and Holstein. In the duchy of Holstein, besides a share of the Elbe, there are the small rivers Haer and Trave, the former of which discharges itself into the Elbe at Gluckstadt, and the latter falls into the Baltic. Most of these rivers are navigable to a certain height for smaller vessels, and their mouths afford convenient harbours and anchorages.

Lakes.

The lakes of Denmark, though numerous, are none of them of any great extent. The lake of Ploen in Holstein, which is one of the largest, does not exceed ten miles in circumference.

Seas.

The seas of Denmark are the Northern or German Ocean, or, as it is called in Denmark, the Western Sea, and the Baltic, chiefly that part of it which is denominated the Categate. This sea is remarkable for the difficulties which it offers to navigation. It abounds in currents, and in sands, which often changing their situation, deceive the vigilance of the sailors. The storms too of the Categate are most violent, particularly towards the end of autumn, when vessels are exposed to the greatest dangers. In this sea, as in the whole of the Baltic, there are no tides, and its waters are less salt than those of the Ocean.

Straits. The straits formed by the Baltic, between the Danish islands, are numerous. The most remarkable of these are the two Belts and the Sound. The Little Belt, having Sleswick and Jutland on one side, and Funen on the other, at its greatest breadth between Arroe and Alsen, is about nine miles over. It is not more than one mile between Snohoe and Middelfart. The Great Belt divides the island of Funen from that of Zealand. Its breadth, at the usual passage between Nyborg and Kerser, is about eighteen miles; and at other places becomes still somewhat straiter. The Sound separates the island of Zealand from the Swedish province of Schonen. From Elsineur on the Danish to Helsenburgh on the Swedish coast, where it is narrowest, it is nearly four miles over. Through this strait, one of the most celebrated and most frequented in Europe, almost all ships bound to the Baltic pass. And it is here that the King of Denmark exacts from the merchant vessels of all nations, that toll which forms a considerable source of his revenue, and which is an acknowledgment of his sovereignty of those seas.

Gulfs. The Baltic also frequently advances into the country; and forms numerous gulfs, called in the language of the country *Fiords*. In Funen are the gulfs of Odensee, of Nyborg, and of Kiertmind. In Zealand is the gulf of Tsfiord, which divides itself into two arms, the one of which advances towards Holbeck, and the other towards Roschild. On the east coast of the Peninsula, the most considerable gulfs are those of Kiel and of Heiligenhafen in Holstein, and of Flensbourg and of Appenrad in Sleswick. To these may also be added the Sleye, in the neighbourhood of the town of Sleswick, which is more properly a long bay than a river. In Jutland are the gulfs of Colding, Veile, Horsens, Randers, and Marriager. These bays afford a number of good harbours, though sand, however, is apt to collect in them. Towards the north-east of Jutland is the great gulf of Limfiord, which penetrates so far into the country, that it approaches within two or three miles of the German Sea, while another arm of it advances southward to the town of Wiborg, a length of about eighty or ninety miles. At its entrance on the eastern coast it is about two miles broad, but afterwards becomes greatly wider. The towns situated on this gulf enjoy the advantage of being sea-ports, though in the heart of the province. But at the entrance of the Limfiord are considerable obstructions, and the depth of its waters has a good deal diminished. Perhaps it may one day become merely an inland lake. At not a more distant period than the commencement of the seventeenth century, it was practicable for ships of war to enter it, though now it will scarcely admit merchant vessels. These are the most important bays on the eastern side of the peninsula of Jutland. When we double Cape Skag, which is the most northern point of Jutland, and enter the Western Sea, the gulfs are less numerous and less considerable. The only gulfs useful for navigation, are those of Husum, Toendern, and Norstrand, in the Duchy of Sleswick. The navigation of the whole of this coast is greatly obstructed by continued shoals and sand banks.

Cities. Almost the only city of any considerable size or importance in Denmark is Copenhagen; though the Danes have dignified with this name above 60 of their towns. This is the capital of the kingdom, and the best built city of the north. It stands on the eastern shore of the island of Zealand, about 25 miles to the south of the Sound; and contains a population of about 90,000. The second city of Denmark is Altona on the Elbe, within a gun-shot of Hamburgh; and containing 25,000 inhabitants. In Zealand, besides Copenhagen, there are Roschild the ancient metropolis, Elsineur, Holbeck, &c. In Funen, Odensee the capital of the island, Nyborg, Sevenborg, and Alsens. In Jutland are Aalborg, Wiborg, Aarhusen, Ripen, Randers, Horsens, Fredericsodde, Colding, Ringkioping, &c. The chief towns of Sleswick are the capital Sleswick, Flensburgh the largest and most populous town of the Duchy, Gottorp, Ekrenford, Fredericstadt, Tonningen, Husum, Glucksburgh, Hadersleben, Tondern, Sunderburg, and Norburg. There are in Holstein, besides Altona already noticed, the towns of Rensburg, Kiel, Gluckstadt, Pinneberg, Itshoa, Wilster, &c. For a more particular description of the cities and towns of Denmark, see the separate articles ALTONA, COPENHAGEN, ROSCHILD, &c.

CHAP. II.

Face of the Country, Climate, Soil, Agriculture, Natural History.

Face of the country. THE aspect of the Danish islands is, in general, pleasant and cheerful, consisting of plains intersected by gentle hills, sometimes insulated, and sometimes continuous, forming agreeable vallies. The heights, for the most part, are clothed with pasture, or shaded by tufts of trees; whilst clear and azure lakes occasionally animate the scene. The province of Jutland presents a ruder aspect, but at the same time more varied and imposing, diversified with majestic forests, upland moors, and fertile pastures. Holstein and Sleswick are level and well cultivated countries, resembling England in their variety of hills, woods, rivulets, meadows, and corn fields. The environs of Ploen are distinguished for their picturesque, and those of Sleswick, Flensburg, and Apenrad, for their romantic beauties.

Climate. The whole of Denmark may be considered as possessing, in general, a humid and rather a temperate climate. The sky is often obscured with thick fogs. The west and south-west winds, which are the most frequent, generally bring rain. It falls in the greatest abundance during the months of October and November. According to a medium of twenty-six years, it rains annually about 130 days, and thunders thirteen. The transition from summer to winter, and from winter to summer, is very rapid; the agreeable seasons of spring and of autumn being but little known. Though the thermometer, in general, does not fall beyond 12° or 13° below freezing, nor rise to more than 25° above it, yet sometimes the heats in summer are very intense; and there are occasionally winters of extreme severity, and the seas are also frequently impeded with ice. The warm weather seldom commences before the end of May or the beginning of June, and the nights are cool during almost the whole summer. The cold sets in about the end of September, and it frequently freezes in October. The coldest months are December, January, and February; but during these there are often thaws for many days. In March and April the weather becomes milder, though it is subject to continual changes. A calm and serene sky, and an atmosphere free of vapours, are seldom enjoyed by the inhabitants of Denmark; but, in general, at least in the higher situations, the air is sufficiently salubrious. The heat is greater, and continues longer in the duchies than in the rest of Denmark. This is particularly the case in Holstein. The influence of the sun, joined to the quality of the soil, produces in some districts

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of this province a luxuriance of vegetation, which reminds us of the fertile countries in the south of Germany; and sometimes the banks of the Elbe and the Trave exhibit the appearance of those of the Rhine, the Maine, and the Neckar.

Soil.

The soil of Denmark is no doubt diversified, but its prevailing character is the sandy, with a greater or smaller mixture of the others; a kind of soil which seems well suited to the humidity of the climate. It is by no means deficient in fertility, and well adapted both for corn and pasture. The soil of Zealand and Laaland is considered the strongest. It is more mixed, and admits of a more varied cultivation in Funen, Langland, and Falster. The soil on the eastern coast of Jutland is rich, and favourable to vegetation; and on the western coast there are extensive alluvions, which might be turned to advantage. Between the two coasts, a sandy ridge extends through the middle of the country, repugnant to cultivation, and producing only heath and some useless plants. At the northern extremity of this province, the coast is covered with a deep stratum of dry sand. It prevails particularly in the environs of the city of Skage, where a great extent of surface presents only the image of sterility. Similar collections of sand are to be met with, after turning the northern point of Jutland towards the west, and also on some parts of the coast of Zealand. These sands being raised in clouds by the wind, desolate the surrounding country, and overspread the cultivated fields. For the purpose of consolidating these sands, various kinds of trees and shrubs are planted, to destroy which is prohibited, under a severe penalty. They sow also in these places a plant called by botanists *elymus arenaria*, whose spreading roots bind the sand, while its large leaves break the force of the wind.

Whirlwinds of sand.

There was published, some years ago, a rescript of the king, for the purpose of directing the public attention to the most likely means of preventing the ravages of the whirlwind in the districts exposed to their scourge. Government, at the same time, circulated a memoir of Professor Wiborg, concerning the plants which grow in sand. In all the higher parts of Sleswick and Holstein, the soil is the same as in the other provinces of Denmark. But on the western coast, from the mouth of the Elbe nearly as far as the frontiers of Jutland, is a soil of a peculiar kind. That district, like a great part of Holland, owes its existence to the agency of the waters, and consists of alluvions, which, for ages, have been insensibly collecting. These depositions of the sea or of the rivers, which are extremely fertile, the industry of man has seized and converted into cultivated fields, a conquest without wars or treaties: But the preservation of this conquest requires the most active and persevering vigilance. The waters often attempt to recover their ancient dominion; and if they meet not with barriers capable of restraining them, they resume their rights, inundate the cultivated grounds, and in a few hours destroy the labours of many years. The most dreadful of these devastations happened in the year 1634. From the mouth of the Elbe to the town of Reben in Jutland, the relentless element carried every where destruction. Besides thousands of cattle and sheep which disappeared in this inundation, there perished above 1500 persons; and houses, mills, and whole villages were swallowed up.

Embankments.

The art of constructing banks has been brought to greater perfection since that disastrous period. They are formed of tough clay, about 19 feet high, and so broad that a carriage can easily pass along them. They are also provided with ditches, canals, and sluices, for containing the water necessary for the irrigation of the soil, and for carrying off what is superfluous. In Wilersmarch they use windmills for drawing the water into the canals. Often thirty or forty of these mills are to be seen in motion at the same time. Men of skill and experience in the construction of such works, who have lately examined the dikes, say, that notwithstanding the improvements that have been made, they are not yet sufficiently secure; and, indeed, it is not long since several districts have suffered by inundations. These works are the object of a special police, and overseers are appointed to see that they are kept in sufficient repair. The governors of the province, accompanied by skilful juries, visit them in spring and autumn. They impose fines on those proprietors who have been guilty of negligence; and such works as are improperly executed are begun anew, under the direction of experienced persons. An ordinance, published in 1800, prescribes an uniform mode of construction, and requires, that all plans of repair shall be submitted to the inspection of persons named by government for this purpose. In 1794 and 1795, the bank of Copenhagen advanced nearly a million of rix-dollars to different companies for the construction and improvement of these dikes.

Alluvions.

New alluvions are continually forming on this coast, which, when they have attained the requisite maturity, are inclosed by new dikes. Such a piece of ground is called *Kog*. As very considerable outlay is required for such undertakings, government grants a complete franchise to those who accomplish them. The remains of ancient embankments, frequently met with in the interior of the country, indicate these successive extensions of the land. Holstein and Sleswick are thus naturally divided into two different regions: the one consisting of those districts which have thus been reclaimed from the sea, and which occupy the western side of the peninsula; and the other comprehending the higher grounds on the eastern side. The former of these divisions is called Marschland, or the Marsches, and the latter Geestland. The superior stratum or soil of Marschland is composed of a rich fat earth, more or less mixed with sand; the second stratum is pure sand, sometimes mixed with gravel; and the last consists of a bluish coloured clay, which, being spread upon the surface, makes excellent manure. The whole of this part of the peninsula is one uniform plain, without any other elevations than the dikes. The sameness of the scene, however, disappears amidst the pleasure which the beholder derives from the general appearance of prosperity, the richness of the cultivation, and the triumph of man over an element the most formidable.

Diseases.

As might be expected from the humid climate of Denmark, and its low situation, surrounded on all sides by seas, and the frequent and sudden changes in the temperature of the atmosphere, those diseases which arise from obstructed perspiration, such as rheumatism, catarrh, &c. are prevalent. Cutaneous diseases were formerly very general, but they have now greatly decreased. In the lower districts of Sleswick and Holstein there often prevails a very obstinate disease, known by the name of the Fever of the *Marsches*. Upon the whole, the climate of Denmark is by no means unhealthy, and the inhabitants often live to a very advanced age.

Agriculture.

The agriculture of Denmark may be compared with that of Great Britain, which it very much resembles, and supplies the inhabitants with all the necessaries and

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conveniences, if not with the luxuries of life; though the state of bondage in which the peasants are held, must be very unfavourable to agricultural enterprise and improvement. Since the middle of the last century, however, when considerable ameliorations took place in the condition of the labouring classes, and particularly within these last thirty years, agriculture, in all its branches, has been very sensibly improving, and has attracted much of the attention both of the public and of the government. In the year 1757, an economical society was projected at Copenhagen, and it commenced its labours in 1768. It was founded by individuals, but soon obtained the support of government. A donation of 3000 rixdollars was received on the part of the king, who has since annually contributed 1400. The members who, independently of correspondents, and of such foreigners as are fellows, have amounted, of late, to about 200, contribute each at least ten rixdollars yearly. The chief object of this society, is to promote improvements in agriculture, in the fisheries, and in the mines. A select committee holds once a year a public meeting, at which the prince royal presides, for the purpose of awarding prizes to useful memoirs, to industry, and to inventions. These prizes consist of honorary or of pecuniary rewards. From 1772 to 1792, the society distributed, in this way, 68,000 rixdollars to 4200 individuals. Count Otton-Thott and General Clasen have also founded prizes, to be decerned by the Copenhagen Society to the best works on general economy, and to the inventors of useful machines, either for agriculture or the manufactures; and General Clasen has bequeathed an estate, the rent of which is to be employed in the maintenance of an agricultural school. About this time, too, measures were adopted for the suppression of commons, which were very numerous in this country, and of very little advantage. The boundaries between the grounds belonging to the different villages and farms had been totally neglected, and the limits altogether unascertained, which occasioned not only innumerable disputes, but was also evidently a great drawback on improvements. The straighting and settling the boundaries of the different proprietors, have, therefore, been publicly recommended, and surveyors for making the necessary measurements distributed over the country, to the number of not less than forty. Government has also marked out to the proprietors of tythes a plan of reform on that subject, but has left the execution of it to their own patriotism and good sense. The greater part of the tythes of the clergy have already been commuted according to this plan, and it is probable that the others will be so also in the course of time. Servitudes also are diminishing, or becoming, at least, less burdensome, in consequence of agreements entered into between the proprietor and his vassals. The great proprietors. in order to enable the peasants the better to improve the soil, grant them hereditary leases. They have increased also the number of farms, by subdividing their estates; a practice, however, which, when pushed too far, is unfavourable to agriculture. The lands belonging to the crown, to cities, and to pious foundations, are very considerable. Of these a great part have been sold, and others are farmed according to the most approved principles. After this great alienation of the property of the crown, the king still possessed in the bailiwicks of Cronborg and Fredericborg some estates on the ancient footing. These estates have been measured and parcelled out into farms of nearly an equal extent. The servitudes and the tythes are suppressed or converted into obligations less burdensome. An annual sum of 30,000 rix dollars is expended on these farms in improvements of various kinds. The property of them is granted to the peasants on the sole condition of discharging the stipulated commutations. More than five hundred farmers have already been settled in this manner, and in the space of a few years their farms have tripled their value. Several private proprietors, emulating with a laudable zeal the example of their sovereigns, have given freedom to their peasants, released them from the burdens under which they laboured, and granted them every indulgence and encouragement. These public-spirited individuals have by these means, at the same time, promoted their own interest, and advanced the value of their estates much beyond those of their less patriotic neighbours. In the low district of the duchies of Holstein and Sleswick, the cultivator has always been free, and often the proprietor; and even in the higher lands, where bondage has long prevailed, many favourable circumstances have softened the yoke. There are here cultivators who, by their mode of farming, and particularly by their manner of cropping, give to their lands a productive power, from which they draw the greatest advantages. In 1786, there was formed, under the eye of government, an office denominated a *chest of credit*, the object of which was to furnish advances of money for the purpose of facilitating the agricultural improvements of the country. The original capital was about 750,000 rix dollars, consisting of property belonging to the crown, on the credit of which, the directors of the chest negociated money with the bank and private individuals. At first, this chest furnished advances at two per cent. in some cases, and in others at four. But since 1793, it has lent at four per cent. in all cases. Before granting these advances, information must be obtained concerning the nature of the undertaking, and the probability of reimbursement. The sum granted is furnished at intervals of six, twelve, or eighteen months, and sometimes of two years; and before any of the remaining portions can be obtained, satisfactory proof must be given that the former has been laid out according to its intended destination. The reimbursement is effected by a small annual payment in proportion to the loan, so as that the whole debt shall be liquidated in twenty-one, twenty-six, or twenty-eight years. This establishment, in the course of twelve years, has lent to the amount of three millions, and government has permitted them to raise their capital to five millions. One part of the sums advanced has been granted for the improvement of the soil and husbandry of the Isles of Jutland and of the duchies of Sleswick and Holstein. Another part has been set apart, as was already mentioned, for enabling the inhabitants of the low district of the duchies to preserve and complete the dikes, an object essentially necessary for the preservation of the land. And the peasants of Denmark have obtained sums, more or less considerable, for the acquirement of property, and for buying up their burdensome servitudes. Norway has always obtained a proportion of these advances for similar purposes. The direction of this institution is entrusted to men whose characters raise them above the suspicion of all personal considerations, and who are particularly enjoined to administer its funds with prudence and impartiality. These encouragements afforded by government, joined with the efforts of enlightened patriots, have diffused a taste for agriculture throughout all the Danish states.

Economical society of Copenhagen.

Chest of credit for agricultural improvements.

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Vegetable productions.

The temperature of Denmark admits of the culture of all kinds of grain. It is the nature of the soil on which the choice depends. The island of Zealand yields the greatest quantity of barley and oats; that of Funen yields chiefly buck wheat. The isles of Laaland and Falster are best adapted for wheat. Jutland is well fitted for the culture of rye. Pease, beans, and lentils, are found in almost every part of the country. Forage is in general abundant, and the meadows have been much improved by the suppression of the commons. The duchies produce the principal kinds of grain in sufficient abundance for the support of the inhabitants, and also for exportation. The high grounds are most proper for the cultivation of rye, buck wheat, and oats. The sandy ridge, which pervades the whole length of both provinces, is fit only for oats or buck-wheat. The district of the Marsches present a picture of the most luxuriant cultivation. Wheat, barley, oats, pease, beans, thrive there most astonishingly. A considerable extent of soil is here allotted to the cultivation of rape. This plant, whose seed yields an oil much esteemed in Holland and in Germany, brings great profits to the cultivator. A part of the seed is prepared in the country, another part is exported without preparation. The refuse of the seed is good food for cattle; the stalks make good manure, and sometimes they are used for fuel. Sleswick alone, sends annually nearly 8000 tons of rape-seed to Holland. The potatoe, that most useful root, was at first despised in Denmark as in most other countries, but it is now more esteemed, and whole fields are appropriated to the cultivation of it. Common cabbage, and the different kinds of turnips and carrots, are very generally cultivated, and form a considerable portion of the ordinary food of the peasant. The isle of Amak, which has been called the garden of Copenhagen, furnishes that capital with an immense quantity of pulse and pot-herbs. This establishment owes its origin to the desire of Isabella the wife of Christian, of finding in Denmark the pulse and vegetables she had been accustomed to in the Low Countries. With this view, cultivators were brought from that country, and part of the Isle of Amak assigned to them, with numerous privileges, which their descendants still enjoy. Gardening has made considerable progress around the capital, and also in the provinces. Fruit trees are generally cultivated. Cherries, plumbs, pears, and apples, are often an abundant crop. In the low lands of Holstein, fruit trees thrive exceedingly. In Sleswick, the districts of Lundwit, and of the Isle of Alsen, are famous for the culture of apple-trees. Vessels often sail from the ports in the neighbourhood of their orchards laden entirely with apples, which they sell to great advantage in Norway and Russia. A single peasant will gain in this way the sum of 200 rix-dollars in one year. For encouraging the culture of fruit-trees, many proprietors, and in some instances government, have established extensive nurseries, from which they supply with trees the peasants and the other inhabitants of the country. Hops are cultivated to a considerable extent in Funen. The produce, however, is not sufficient for the consumpt of the country, which imports hops yearly to the value of 50,000 rix-dollars. There are some grounds appropriated to the cultivation of tobacco in the islands of Zealand and Falster; but this plant is chiefly cultivated in the environs of Fredericia in Jutland, by the French refugees invited thither by Frederic the Fourth. Under the reign of Christian the Fourth, the cultivation of flax and of hemp was recommended by royal authority. This recommendation has since been frequently renewed. But it is only very lately that the culture of these plants, which is of great importance in a maritime country, has been attended to by the generality of farmers. Nature produces, in many parts of Denmark, an useful plant, and which a small expence of labour would render more common, the herb manna, probably so called, because it is spontaneous, and because its seed is gathered in the morning before sun-rise. This plant, which delights in moist and marshy grounds, might be food for horses, while its seed, when ground, gives a meal of a good quality. Besides this, there are many other natural plants, of which the inhabitants might avail themselves more than they have hitherto done. In Sleswick and Holstein, hops, tobacco, flax, and hemp, have as yet been but little cultivated. For these several years past, in the district of Dithmarsh, the gathering of medicinal herbs, which grow there naturally, has furnished a lucrative source of traffic.

Animals.

The rearing of cattle is in Denmark an important object of rural economy, and has received a great degree of attention from government, who have founded at Copenhagen a public seminary and institution for the purpose of encouraging and promoting it. The horses of Denmark have been long known over Europe. Those of Jutland, and in particular of the district of Thyeland in the north of that province, are reckoned the strongest, but they are not so well shaped as those of Zealand and Funen. It is, however, in the duchies, and particularly Holstein, that we find that fine breed of beautiful steeds every where in such request. They are distinguished by their stately chest, their shape, their gait, their fire, and require better feeding than those of the other provinces of Denmark. From the bosom of their peaceful vales, these noble animals are conducted at great expence into foreign regions, to listen to the warlike trumpet, and carry the combatant through the ranks of the enemy; or to adorn the processions of the great, and drag in gilded chariots the illustrious favourites of fortune. The chief trade in these horses is carried on at Altona and Husum, from whence they are exported to Germany, Russia, Prussia, and France. Stallions from the king's stables, are distributed over the country for the accommodation of breeders; and those who rear the best horses are rewarded with prizes from the inspectors of studs appointed by government. In the year 1797, there was exported from Jutland and the isles 6000 horses, from Sleswick, 3647, and from Holstein 6386, which would bring into the country about 250,000 pounds sterling. The horned cattle of Denmark are also of a very excellent breed, and furnish an important article of exportation. The cows of the eastern coasts of the duchies, are of peculiar excellence, and particularly the large reddish coloured cows of the district of Eystersted, which, it is said, will give twenty-four cans of milk per day. For a long time the privilege of trading in cattle and of fattening them, was exclusively enjoyed by the great proprietors, by the farmers of the royal demesnes, and by the cities, to whom, according to fixed regulations, the peasants were obliged to bring the cattle reared on their pastures. Those only of a certain age and quality were allowed to be exported. Under all these restrictions and disadvantages, this branch of commerce was carried to a great extent. In 1788, government, however, suppressed the exclusive privilege of feeding and dealing in cattle, and all the burdensome enactments to which it had given rise. The export duties were lowered, and the expor-

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tation of lean cattle, which was not before allowed, was also permitted. In 1774, the number of horned cattle throughout the whole of Denmark, was 640,211 cows, and 131,762 oxen.

In 1798, the exports from the isles and Jutland were 22,000 cattle, and 9000 tons of salted beef. In many districts are made immense quantities of butter and cheese, which are exported to different parts of Europe. Their dairies are placed on the same footing as those of Holland. The finest butter is that of Holstein; and connoisseurs esteem particularly the cheese of Eystersted in this duchy, and of Thyboe in Jutland. The rearing of sheep is another important branch of the rural economy of Denmark, and government has been at great pains to procure from other countries the best species, and those most suitable to the situation and climate, for the purpose of improving the native breed. It is in the low districts of Sleswick and Holstein, and particularly in the district of Eystersted, that the most valuable species is to be found. This breed is distinguished by the length, the fineness, and the whiteness of their wool. About 150,000 pounds of this wool is produced annually, of which 30,000 are used in the country, and the remainder is sent into the other provinces of Denmark, to Hamburgh, and to Holland. In the higher districts of the duchies, too, as well as in Jutland and the isles, great numbers of sheep are raised. Their wool, though it has not the superior qualities of that of Eystersted, of England, or of Spain, is, nevertheless, very valuable for the purposes of the country. The wool of the islands, excepting that of Zealand, is somewhat inferior. They sheer the sheep twice in the year. They are also in the habit of milking the ewes, for the purpose of making cheese. A Danish writer has computed the number of sheep in Jutland and the islands at 849,000. Goats, which are not allowed to be at large in Denmark, are scarcely to be found, except in the heaths of Jutland. Swine are raised in great numbers, and the farmer often derives considerable profits from these animals. The breed in the eastern parts of Jutland is small, and easily maintained. Those of the west are larger, and sometimes weigh eighteen stones. Besides supplying themselves, the inhabitants send annually about 10,000 cwt. of bacon to Norway, Holland, Hamburgh, and Lubeck. Great numbers of live hogs are also shipped on the Eyder and the Elbe. Poultry of all kinds form a profitable part of the produce of most farms, particularly geese and ducks, whose feathers are sold to great advantage for beds. The culture of bees, though formerly more extensive, is by no means neglected. In the islands of Funen, Falster, and Bornholm, the greatest quantity of honey is produced. The culture of bees is also very general in the peninsula; the schoolmasters in particular attend to it, and practise it very successfully.

Wild animals.

The immense forests, which formerly covered a great part of Denmark, abounded in wild animals. But in proportion as these forests have been cleared, and agriculture has improved, the more ravenous and destructive species have here, as every where else, almost entirely disappeared, and the others have greatly decreased. Boars are now no where to be found. The wolves are reduced to a very small number; but foxes are numerous, and hunting them a very common amusement. The hart and the deer are not scarce. Hares are plenty, and we sometimes meet with rabbits, though this animal does not appear to be a native of Denmark. The principal wild-fowl are the wild goose, the wild duck, the snipe, the swan, the moor-fowl, the woodcock, &c. This last is chiefly found in the woods of Jutland. Sea-fowl abound in the districts of the marshes, and on the small islands on the western coast of the peninsula. The island of Sylt furnishes annually nearly 40,000 wild ducks.

Fisheries.

The fisheries are of much more importance. It is said that the fishes were formerly more abundant in the Danish seas than they are now. The produce of these seas, however, is still sufficiently important, and might become yet more so were the fisheries under better regulations. The coasts of Zealand, of Funen, and of the other islands, furnish productive fisheries. In these seas the mackerel and whiting abound. Of all the waters which wash the Danish coasts, those of Limfiord, with its numerous arms, seem best adapted for this purpose. Here they fish chiefly herrings and eels. In the neighbourhood of Skag and Fladstrand, as well as on the whole coast of Wensyssel, they take the best fish, flounders, and cod. The gulfs of Mariager and Randers are full of fish, and afford excellent salmon. In the gulf of Veyle are found several kinds of flat fish, herrings, and small cod. In all these gulfs the sea is so little salt, that fresh water fishes thrive in them. The carp of Limfiord are not, however, so good as those of the ponds. On the western coast of Jutland, the greater part of the inhabitants are employed in the fisheries. The salmon, the bretfish, the flounder, and the cod, are the principal species found in those parts. According to the registers of the custom-house of Aalburg, this city exported yearly from 1720 to 1730 above 23,109 tons of salted herrings, but from 1754 to 1765 their exportation amounted only to 8298 tons. The Swedes, who had hitherto been supplied with herrings by the Danes, now began to rival them in this branch of industry. The want of credit diminished the fisheries of Limfiord; and at present the greater part of the herring taken on the coast of Jutland are consumed in the Danish states. The white fish are dried and salted, and either sold in the country, or sent to Lubeck, the merchants of which place forward them to Italy and Poland. In the river or bay of Slie and the gulf of Flensburg, are taken a small species of herring of excellent quality. This fishery, which was famous several centuries ago, still exists. The herrings make their appearance in March, April, and May; they are found also in autumn, but in small numbers. The proprietors whose lands lie along the Slie, to whom the fisheries belong, farm them out. Besides what are consumed in the country, they export annually of the herrings taken here, nearly 1000 tons to Germany and Copenhagen. The fishery of the small cod called *aigrefin*, below the island of Heligoland, employs about three hundred individuals, and a number of vessels of particular construction. The inhabitants of the village of Blankensen, and of some other places on the lordship of Pinneberg, employ about 150 vessels in the neighbouring fisheries. The produce, which is valued at 100,000 dollars yearly, is carried chiefly to Altona, Hamburgh, and Holland. In 1767, there was established at Altona a North sea herring company. The grant was for ten years; but before the expiration of that term, the king bought up the deeds, and the fishery has since been carried on, on his account. In both the fishery and the preparation of the herring, they imitate, as nearly as possible, the practice of the Dutch. The produce amounts to 6000 tons yearly, a considerable part of which goes to Hamburgh, to St Petersburgh, and even to Hungary. The coasts of Jutland possess oyster-banks, rich enough to afford a considerable supply for exportation. Among the islands situated along the western coast of Sleswick, are found

Statistics.

oyster-banks still more valuable, which belong to the crown, and the formation of which is ascribed to Canute the Great. These banks are sometimes half a mile in length, and 14 feet under the water. The produce of this fishery, which is let to a merchant of Toendern for 75,000 dollars payable per advance, is sold in the provinces of Denmark and the North of Germany. The superior quality of these oysters is ascribed to the fresh waters, which, in spring, are let into the sea through the sluices and the canals. The lakes, the rivers, and ponds, contain pike, perches, carp, eels, and cray-fish. The fisheries of Gessenfield owe their origin to Peter Oxen, who brought the first carp from France in the end of the sixteenth century, and recommended the propagation of this fish in the fresh waters of Denmark. Most of the large estates, particularly in Holstein, have ponds, some of which will produce 800 rix dollars per annum. Many of these fisheries also belong to the king, some of which are let, and others managed on his account. All these fresh water fisheries might be improved and rendered of much greater value.

Minerals.

Although Denmark contains none of the primitive or transition rocks, and but few of the flætz series, and is almost entirely destitute of the more beautiful and striking minerals, still its mineralogy is by no means uninteresting.

The basis or fundamental rock of Jutland, Sleswick, Holstein, Zealand, Laland, Falster, &c. appears to be sandstone; on it rests chalk, which varies in hardness, contains flint, and also numerous petrifactions: the chalk is covered with, or contains beds of gypsum, which sometimes forms considerable eminences, as at Segeberg, near Kiel. These are all the flætz rocks hitherto observed in Denmark, (with the exception of Bornholm, afterwards to be mentioned). They occur but seldom at the surface, owing to the universal and frequent deep cover of alluvial strata. The most striking sections are on the sea coast; and of these the most remarkable is that of Stevensklint, in Zealand. Immediately over the chalk rests a remarkable bed of marl, from a few feet to upwards of seventy feet thick: it contains fragments of chalk, and abundance of loose masses of flint. It is covered with a bed of loam, and there is observed an uninterrupted transition from the loam into the subjacent marl; and both of these beds appear to have been formed from the chalk. Superimposed on the loam is a vast bed of sand, which is sometimes in the state of blowing sand, and is then very destructive to the labours of man, or is more or less aggregated together by means of clay or marl, so as to form a kind of sandstone. In some places we observe beds of this sandstone alternating with a peat, which is uncommonly like coal. The sand is covered or intermixed with boulders, or rolled stones of different kinds, as of granite, gneiss, sienite, porphyry, &c. which, from their nature and their connection with the subjacent alluvial matters, appear to have been transported from the mountains and hills of Scandinavia and Germany, by that commotion of the water which opened a communication between the Baltic and the North Sea. This sand is more or less extensively and deeply covered with peat, which is the principal fuel of these countries; and sometimes the peat is associated with bog-iron ore.

The minerals of Denmark, in an economical point of view, are not of very great importance. Coal, that most useful mineral, occurs but in small quantity, and, as far as we know, only in the island of Bornholm. Peat, as we have already remarked, is the principal kind of fuel; and some varieties of it are so bituminous, that the peasants make use of it instead of candle. Amber is found, along with brown coal, in the island of Bornholm; also floating on the coasts of Zealand, and other islands in the Baltic. The island of Bornholm also furnishes good porcelain earth, excellent building stones, and also small but beautiful transparent rock crystals, which are situated in a variety of marl; and a kind of limestone, which is considered as of the nature of marble. Near Kiel, in Holstein, there are gypsum quarries, which have been worked for a long series of years. Those of Segeberg, which belong to the king, employ about seventy individuals, and from 1773 to 1793 yielded a profit of 1,192,351 dollars. The salt springs in the neighbourhood of Oldesloe have been known since the twelfth century. The water is raised by means of mills and pumps into the buildings prepared to receive it, and the process is the same as takes place in other salt works of the same nature. The number of workmen employed is about forty; and the quantity of salt produced is 18,000 tons annually, which is more than sufficient for the consumption of the country. The inhabitants of Jutland procure a small quantity of salt from sea-weed, after burning it to ashes.

Forests.

The extensive forests which at one period covered almost the whole of Denmark, as was mentioned already, have now generally disappeared. In some districts of Zealand and Funen there is a considerable quantity of wood, and in Jutland there are still some large forests. We also meet with extensive forests in Sleswick, in the district bordering on the Baltic. The trees in these forests are chiefly the oak, the beech, and the ash. The city of Itzhoe in Holstein exports wood to Hamburgh and Holland; and the burgh of Elmshorn in the same province carries on a lucrative trade in charcoal.

CHAP. III.

Manufactures.

Manufactures.

The manufactures of Denmark are neither many, nor very important. Government has made frequent attempts to extend them; but by aiming rather at the introduction of foreign manufactures, than at the encouragement of those suited to the country, and also by interfering too much with individual enterprise, their well meant endeavours have not been crowned with all the success that was expected. It is evident, from the constitution of the Danish corporations, that the knowledge of the mechanical arts, and almost all the different trades, have been introduced into this country, or at least brought to perfection, by Germans. Indeed, the greater part of the tradesmen employed in all the northern states, came originally from Lubeck, Hamburgh, Bremen, and the adjacent countries; and we still meet with great numbers of these German artizans in Copenhagen, and in many of the other Danish cities. The native tradesmen, though they exact high wages, work but slowly, and have very little taste. Their education is much neglected; but an institution was founded at Copenhagen in 1798, for the instruction of young mechanics, which may be attended with considerable advantage. The vassalage of the peasants, who can exercise no trade but by the permission of their lords, and the corporation monopolies, have been unfavourable to the increase and prosperity of the manufacturing and mechanical arts; but several late enactments have very considerably diminished the evils of these systems. It is in Copenhagen that the greatest encouragement has been given to manufactures, and the chief manufactories of Denmark are in this city and its environs. Some cities in Holstein and Sleswick are declared free; and the effect of this on their prosperi-

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ty, particularly on that of Altona and Christiansfeld, is very sensible. It is in these two cities that the most skilful artizans are to be found.

Woollen cloths.

The manufacture of woollen cloths is one of the most considerable, and is very suitable to a country in which this article forms an essential part of dress, and which is so well adapted for the rearing of sheep. Denmark has furnished, for many centuries, wool for the coarse cloth which the peasant wears, and which he frequently manufactures himself. But besides what the district of Eystersted furnishes, they import for finer cloths a considerable quantity from Poland, Spain, and Mecklenburgh. The number of hands employed in the woollen manufactories in Copenhagen, in the islands, and in Jutland, is not less than eighteen hundred. The value of the original materials may be about 97,000 rix-dollars, and that of the articles when manufactured 165,000. They manufacture also shalloons, camlets, and cassimires, for which purposes they use chiefly the wool of Eystersted. The produce of these manufactures is reckoned at 94,000 rix-dollars, and the original materials at 41,000. The great manufactory of woollen cloth for the use of the army, was established at Copenhagen in the reign of Frederic the Fourth. It employs about 1200 hands, and delivers yearly between a hundred and forty and a hundred and fifty thousand ells.

Hosiery.

About 70 looms are employed in the capital in the manufacture of stockings, nightcaps, mittens, and other articles of woollen hosiery, to the annual amount of about 27,000 rix-dollars. There are similar manufactures at several other places. The peasants of Jutland furnish a considerable quantity of stockings. The single community of Hoeringsholm has sold in one year 20,000 pairs. Father, mother, children, servants, are all busily employed during the winter evenings, some carding, some spinning, and others knitting or working on the loom. The produce of this commendable industry yields yearly not less than sixteen thousand dollars. It is carried to Copenhagen, from whence it finds its way into the provinces, and sometimes into foreign countries.

Manchester cloths.

There has been established at the gates of Copenhagen a manufactory of Manchester cloths. It was erected according to the English fashion, by a Swede of the name of Norberg, for the behoof of the king, but it has since been sold to individuals. This extensive establishment is well conducted, and gives support to about two hundred people. They manufacture both cloths, entirely cotton and also mixed. They sell annually to the value of from twenty to thirty thousand dollars. There has sometime ago been erected another manufactory of the same kind, in the bailiwick of Hirseholm, a few miles from Copenhagen. In that place cotton stockings are manufactured, but in small quantities, the annual value not being above two or three thousand dollars.

Calicoe printing.

For a long time, one particular establishment enjoyed, on advantageous terms, the exclusive privilege of printing calicoes. But this branch of manufacture has been free since the year 1754. Besides seven large manufactories of this kind, employing about 360 persons, there are several smaller ones. Altogether they print yearly goods to the value of about 366,000 rix dollars.

Linens.

The manufacture of linens, &c. will not flourish, it is probable, until the country itself produces a greater quantity of the materials. The annual importation of flax and hemp into Norway and Denmark, amounts to the value of 460,000 rix dollars. There are four manufactories of linen cloth in this country, one in Zealand, one in Funen, and two in Jutland. These employ about fifty-five looms, and make about 25,000 ells of cloth of different qualities, yearly. In the villages throughout the country a considerable quantity of linen is manufactured, both for domestic consumption and also for trade. That of Jutland is of the best quality. The town of Aalborg has sometimes exported in the course of a year about 60,000 dollars worth of linen, manufactured by the Jutland peasants. Denmark does not, however, furnish linen cloth sufficient for the consumption of the country, but obtains a very considerable supply from abroad.

Sail cloth.

There is only one manufacture of sail-cloth deserving to be mentioned. It furnishes employment to about 400 persons, and yields a produce worth about 18,000 dollars. The rest of this article is brought from Russia.

Cordage.

There are rope-yards at Copenhagen, Elsineur, and several other places. But great quantities of cordage are yearly imported, and chiefly from Russia.

Silk.

The silk manufactures, say the Danish writers, have cost the public not less than 200,000 dollars in prizes and other encouragements of various kinds. The result of these efforts has not, however, answered expectation. The number of looms employed at present in the manufacture of silk-stuffs, may be from 140 to 150. In 1789, there were six ribbon manufacturies, employing about 40 looms, and 313 workmen. The annual produce was about 32,175 rix dollars.

Gauzes.

In the same year, there was about 38 looms for gauzes, employing about sixty-seven hands, and producing about 17,400 dollars. The annual produce of the manufacture of silk-stockings will amount to 13,000 rix dollars.

Paper.

Denmark has long paid a considerable tribute to foreigners for the different kinds of paper. About 1759, this article cost them at an average 15,000 rix-dollars yearly; and in 1793, upwards of 100,000. One of the greatest obstacles to the establishment of paper manufactories, is the difficulty of procuring rags. Various measures have been resorted to for removing this obstacle, which it is hoped will in time succeed. The paper manufactory at Joegersborg furnishes yearly about 15,000 dollars worth of paper. That at Roschild is quite inconsiderable. An extensive paper manufactory was erected some years ago, but the great supply is still derived from abroad. Copenhagen has a good manufactory of paper for household furniture. It has likewise two manufactories of cards, which furnish Denmark, Norway, and the duchies, with 144,000 packs yearly, all of which must be stamped.

Leather.

For the encouragement of tanneries, the exportation of raw-hides was prohibited in 1746. These manufactories have, indeed, since that time, increased, but have never yet been able to supply the wants of the country. There is one leather manufactory in Copenhagen, and another about two miles from the capital, of which the annual sale amounts to between thirty and forty thousand dollars.

Gloves.

The city of Randers, in Jutland, has been long famous for the manufacture of dog skin gloves, but they are now reduced to a very small number; and this manufacture has been, for some time past, chiefly carried on at Odensee in Funen, where they also make saddles and harness, that are much in request.

Refining of sugar.

Since the acquisition of the American islands, the refining of sugar has formed one of the manufactures of Denmark. The company which, in 1734, obtained the exclusive privilege of trading to these islands, procured also the sole right of refining sugar, and of supplying with this article the Danish states. But in 1754, this monopoly was abolished. There were, in 1793, seven sugar houses in Copenhagen, containing in all 68 boilers; but in general the third or fourth part of these boilers were not at work. These sugar-houses employ 340 workmen, and refine 13,770,000 pounds of sugar yearly. Besides the sugar-

Statistics.

houses of the capital, there are two at Elsineur which manufacture 800,000 pounds of the raw material; one at Odensee, which manufactures 700,000; and two at Alborg, which manufacture 300,000. The distillation of spirits from grain is an important branch of manufacture in all the countries of the north. In Denmark there are many distilleries, but those of Copenhagen have long been the most considerable. The distillers, in number three hundred and sixteen, form a corporate body, enjoying some peculiar privileges. In 1800, the distilleries consumed 287,824 tons of grain, which yielded 2,347,850 gallons of spirits. The first soap-houses in Denmark were established in 1662, at Copenhagen. There are now six or seven in this city. There are soap-houses also at Aalborg, and in some other places. The total produce of these manufactories is valued at 72,000 rix-dollars; and the original materials, which are brought from abroad, cost about 32,000. The inhabitants of the village of Worup, in the canton of Worde, and of many other places in Jutland, have, for a long period of time, manufactured a species of black pottery, remarkable for its solidity and its lustre, and much in request, not only in Denmark, but also in Hamburgh and Holland. The earth which they employ for the purpose, is a fine bluish clay found in the neighbourhood, to which they add a mixture of sand, carefully cleaned. This branch of industry produces, within three parishes, nearly 13,660 rix-dollars yearly. There are manufactures of earthen ware also in the isles of Bornholm and Falster. At the village of Castrup, in the isle of Amak, is a manufactory of delft-ware, which sells readily in Copenhagen. In 1774, a manufacture of porcelain was established at Copenhagen by public subscription, under the direction of Francis Henry Muller, a man of great chemical knowledge. But the profits of this manufactory, which the king was at last obliged to purchase to prevent the ruin of the individuals concerned, have never yet covered the expences of the establishment. To encourage this manufactory, the importation of foreign porcelain is prohibited, with the exception of what is brought from China by the ships of the Asiatic company. At Fredeickswaeerk, there is an extensive manufactory of brass cannon, mortars, bombs, balls, and powder, for the use of the army and navy. From 1762 to 1772, this manufactory delivered nine hundred pieces of cannon and mortars, twenty thousand bombs and grenades, and 3,000,000 pounds of powder. In 1802, the number of workmen employed in this manufactory was 920. Another manufactory, situated in the neighbourhood of Elsineur, furnishes annually 3500 muskets, and a great quantity of bayonets, pistols, and sabre blades, and gives employment to 400 people. In Copenhagen there is a manufactory of nails, &c. belonging to a company of merchants. There has also been established in the same city, another manufactory of ironmongery goods, by an individual. Two miles from Copenhagen, on the banks of a small stream, are three brass foundries. In these there are generally 300 workmen employed; and the annual consumption of brass, when the sale is good, is about 94 tons. There has been a foundery of printers types in Copenhagen since the year 1740, which supplies the printers of the country, and sometimes makes exportations to Sweden and Russia. There are various other manufactories in Denmark, which are either too inconsiderable to merit particular description, or of which the extent and importance have not been sufficiently ascertained; such as the manufactories of sealing-wax, of hair-powder, and of starch; as also those of tiles, of bricks, of tobacco, of tobacco-pipes, of hats, and candles, &c. In the duchies of Sleswick and Holstein, which are chiefly agricultural countries, the manufactures have not been carried to any very great extent. These provinces are not, however, altogether destitute of them. There are manufactures of woollen cloth, of carpets, and of bedcovers, at Husum in Sleswick, and at Altona, Neumunster, and Rendsburg in Holstein. Altona and Vansbeck have considerable establishments for the printing of calicoes, in which they carry on a trade. The paper manufactories of Flensburg, and of some other towns; the tanneries of Altona; the glass works of the same city, and its tobacco manufactures, also deserve to be noticed. The distilleries of spirits from grain, at Flensburg, are two hundred in number, which send their produce chiefly to Norway. The distilleries at the same time fatten cattle with the refuse of the grain, which they likewise export. This branch of trade altogether circulates 200,000 rix-dollars yearly. Around the gulf of Flensburg, are a great number of tile-works, the produce of which is sold to advantage in Copenhagen. The Hernhutes, the founders of Christiansfeld, and its only inhabitants, have introduced into it all kinds of manufactures, which are in a flourishing state. Besides the artisans, whose goods are in great demand, this city contains manufactories of woollen cloth, of woollen hosiery, of candles, of soap, and of sealing-wax, as also distilleries and breweries. The manufactures of this place, though high priced, obtain a ready sale.

Distilleries. Soap. Pottery. Porcelain. Ordnance. Fire arms. Iron goods. Brass foundries.

CHAP. IV.

Commerce.

Internal commerce.

No country can be better adapted for internal commerce than Denmark. The seas with which it is encircled and intersected, and its numerous gulfs which often penetrate into the very heart of the country, and sometimes extend nearly from one sea to another, afford the utmost facility of communication between the different provinces. These natural facilities of interior navigation which the inhabitants of Denmark possess, are considerably lessened, however, by their neglecting to clear the entrances into the harbours, which are in general much obstructed with the sand and mud that has been allowed to collect for a great period of time. Denmark is by no means distinguished by the same facility of intercourse by land. The roads long continued in the most deplorable condition, and occasioned much surprise and inconvenience to travellers. The public attention was at length directed to this subject, and in 1778, a plan for the general improvement of the roads throughout this country was adopted, and each proprietor assessed in an annual portion of labour or of money for this purpose. This plan has been gradually executing, and there are now some roads in Denmark, particularly that from Elsineur by Copenhagen to Corsær on the shores of the Great Belt, equal to those of any other country. The principal internal traffic of Denmark is carried on in the markets and fairs, which are held in the different cities, at which the manufactures and commodities of the place, and the productions of the neighbouring country, are exposed to sale. With the exception of Copenhagen, Odensee, Aalborg, Ripera, Fredericia, and Aarhuus, most of the cities of the islands and of Jutland are in a very languishing condition. A short and easy communication has been effected between the city of Odensee and the sea, by means of a canal, which cost about 75,000 dollars. Several navigable rivers, the Elbe, the Trave, the Stoer, and the Eyder, facilitate the interior communication of the duchies.

Roads.

Statistics.

Altona, Flensburgh, Kiel, Husum, Christiansfeld, and Tœndern, have the principal share of the commerce of these provinces. There is held annually, in the month of January, a great fair in the town of Kiel, during which time this place is the rendezvous of all that is rich and valuable in the two duchies. The canal of Kiel, which unites, as was mentioned above, the Baltic with the river Eyder, which falls into the German Sea, forms the great inland navigation of Denmark. This important work was begun in 1777, and finished in 1784, and cost nearly 800,000 pounds sterling. Its length is about 22 British miles and a half. Its breadth is 100 feet at the top, and 54 at the bottom, and its smallest depth 10. It admits vessels of 120 tons burden. The vessels from Kiel must be drawn by horses as far as Rendsburgh. From Rendsburgh to the sea, they use sails. The whole length of the navigation from Kiel to Tonningen, or from the Baltic to the ocean, is about 105 miles. Since the opening of this navigation, the passage round Jutland, always long, and often dangerous, has been mostly abandoned. This canal has greatly advanced the trade and prosperity of Sleswick and Holstein, and facilitated the intercourse between all the Danish states. It has also been the means of forming new and lucrative connections with foreigners, who, in many cases, prefer the passage through the canal to the ancient navigation; though every vessel passing this way, is of course subjected to the payment of a toll. The following Table will give the reader an idea of the navigation of the Kiel or Holstein canal.

Inland navigation.

Table of the Vessels which have passed through the Holstein Canal between the years 1784 *and* 1798.

Years.	Danish vessels.	Foreign vessels.	Total.	Years.	Danish vessels.	Foreign vessels.	Total.
1784	...	...	77	1792	787	722	1509
1785	409	44	453	1793	849	1441	2290
1786	333	67	400	1794	927	1192	2019
1787	520	125	645	1795	983	970	1953
1788	490	136	626	1796	921	1258	2179
1789	792	280	1072	1797	925	1180	2105
1790	678	293	961	1798	1086	1164	2250
1791	794	456	1250				

The facility of communication which is thus afforded between Denmark, Norway, and the duchies, is of the greater importance, as those provinces have various articles to interchange with each other. Copenhagen sends to Holstein the American and Indian produce, and receives in return German goods. For a long time past, a packet-boat has sailed between Kiel and the capital. Norway procures from Denmark and the duchies, corn, spirituous liquors, and several kinds of manufactures, and in return furnishes these provinces with iron, copper, fish, and oil. Denmark and Norway can exchange almost all kinds of commodities without any duty. The duchies can import their produce free of duty into either of those provinces, but their manufactures must pay a rate of entry. The trade to Finmark or Danish Lapland, which belonged at first to an exclusive company, and afterwards to the king, has, since the year 1787, been open to all the subjects of the Danish states without distinction. They carry thither corn, spirits, tobacco, cloths, and utensils of various kinds, and bring back fish, oil, rein-deer skins, furs, &c. In 1788, the imports at Copenhagen from Finmark amounted to 42,376 rix-dollars. The trade to Iceland too, was long in the hands of successive companies of Danish merchants, who ruined the province to enrich themselves. In 1789, a free trade with this island also was allowed to all the inhabitants of the Danish states, but foreigners are still entirely excluded. The imports from Iceland, which consist of dried and salted fish, oil, salted beef and mutton, tallow, hides, feathers, eider-down, sulphur, wool, stockings, mittens, &c. amount annually to 200,000 rix dollars. And the commodities sent to that province amount to about 150,000, consisting chiefly of meal, beer, spirituous liquors, wine, woollen and linen cloths, hats, coffee, tea, spices, salt, ironmongery, paper, and soap. Since 1787, Bergen, Christiansand, Altona, and some other places, have shared with the capital the profits of the trade to Iceland. A packet-boat sails in spring from Copenhagen to Iceland, and returns in autumn to Christiansand in Norway.

Commerce with Finmark.

With Iceland.

Denmark imports from the Faroe islands, the trade of which has never yet been declared free, dried and salted fish, oil, feathers, hides, tallow, and woollen stockings, and it sends thither meal, spirituous liquors, tea, coffee, sugar, spices, linen, glass, and several other articles. The exports to these islands amount, at an average, to 22,251 dollars yearly, and the imports to nearly the same sum.

With the Faroe isles.

Denmark sends out a considerable number of vessels to the whale fisheries of Greenland. It imports besides from the settlement, oil, fish, eider-down, and furs, and sends out meal, coarse woollen cloths, tobacco, spirituous liquors, sugar, and spices. The exports to Greenland will amount to about 80,000 dollars yearly, and the imports, including the produce of the whale fisheries, which is fully the half, to about 180,000.

With Greenland.

The commerce of Denmark, with its islands in America, like that, with its other distant possessions, was long carried on by oppressive monopolies. Before the late war with Britain (Feb. 1814.) suspended this branch of their commerce, by depriving them of their islands, the trade to St John and St Thomas had, however, become free to all the subjects of Denmark. Vessels were likewise sent from all the Danish ports to the island of St Croix; but the cargoes they brought home were to be delivered at Copenhagen, unless the ships belonged to some of those cities in which sugar houses had been established. The cargoes destined for these possessions, consisted of laces of all kinds, of iron and of copper, of Danish and foreign manufactures, and of Indian commodities. Sugar, rum, and cotton, were the principal returns of the Danish islands; but indigo, tobacco, mahogany, and coffee, were also procured from other places in those parts, through the medium of these colonies. The number of ships employed in this branch of Danish commerce varied according to circumstances; but they may have amounted at an average to between 70 and 80, of from 80 to 120 tons burden. The Danes carried on a small trade also in one or two ships, with their settlements on the coast of Guinea. They sent out brandy, linen, Indian commodities, gun-powder, and arms, and brought home elephants teeth, and gold.

With the American islands.

The slave trade was long with the Danes, as with the other commercial states of Europe, the principal branch of commerce on the coast of Africa. But this horrid traffic ceased in 1803, agreeable to an edict published in 1792; and let it be recorded to the honour of the Danish government, that arbitrary though it be, in this instance it first recognised the sacred rights of humanity, and led the way in those efforts which the present age is making, to wipe away the disgrace of the civilised world.

Slave trade.

In 1616, a Danish East India company was established by Christian the Fourth. This, as also two other successive companies, have been dissolved. The present East India or Asiatic company was established in 1732, with the exclusive right of trading to all places

East India companies.

Statistics.

between the Cape of Good Hope and China for forty years. They also obtained the government of the Danish possessions in India, and the right of making treaties in their own name with the Asiatic princes. When their charter expired in 1772, it was renewed for twenty years, but with considerable alterations. The commerce with China was again bestowed exclusively on the company, but that with India was opened to individuals on certain conditions. In 1792, the company obtained a second renewal of their charter for other twenty years, on nearly the same terms as the former; but the freedom of the Indian trade was then still further extended. Vessels may now be freighted by private adventurers, not only in all the Danish, but also in foreign ports, on obtaining the necessary licences. Their cargoes on their return, must, however, be brought to Copenhagen, and sold by auction. The number of these private vessels were, in 1797, eleven, of which three were from Danish, and eight from foreign ports. In 1798, there were thirteen, four Danish, and the rest foreign. In 1799, they were the same as in the preceding year. The capital of the Danish East India company is 2,400,000 rix dollars, divided into 4800 shares of 500 rix dollars each. During the American war these shares sold at 1800 and 1900 rix-dollars, and the dividends were as high as cent. per cent. From the establishment of the company in 1732 to 1745, the value of the cargoes sent from Copenhagen for the Indian commerce, amounted altogether to 3,973,474 rix dollars, and the value of the returns to 7,470,761. From 1781 to 1787, the exports amounted to 7,559,444 rix dollars, and the sale of the returns brought at Copenhagen, after deducting the duties, 12,775,872. From 1780 to 1793, the profits of the Indian and Chinese commerce amounted to 6,308,198 rix dollars. Tea, rhubarb, and porcelain, are the principal articles brought from China. The establishments in India furnish calicoes, silks, sugar, rice, pepper, ginger, cinnamon, indigo, opium, arrack, and saffron. Besides the silver for China, Denmark ships for the Indian market, metals, spirituous liquors, pitch, and various manufactures. The vessels employed in the Indian trade are of four hundred, and those in the Chinese of a thousand tons burden.

Trade with India and China.

Foreign commerce.

The foreign trade of Denmark was long in the possession of the Hanse towns, and particularly of Lubeck; but the kings of Denmark wishing to shake themselves free of the Lubeckers, who often interfered in the politics of the North, encouraged commercial intercourse with the Dutch, who reaped the chief advantages of the Danish foreign trade from the middle of the sixteenth to the end of the seventeenth century. About that time the Danes began to desire a commercial marine of their own, which they by degrees acquired; and which, during the almost constant neutrality they have maintained since the peace of 1720, has been vastly increased. The importation of all foreign commodities into Denmark is permitted on paying the stated duties, with the exception of the following articles: Sugar, either raw or refined, coming from European ports; porcelain, coloured delf, cards, burnt coffee, printed calicoes, and a few kinds of woollen cloth. Some articles of necessity, and such as are essential to the encouragement of the arts, are exempted from the rates of entry. The exportation, also, of all sorts of commodities is permitted from the Danish states, on paying the duties, with the single exception of the wood of certain districts in Norway. The merchants of Denmark have formed relations with most of the commercial states. They frequent the ports of the Baltic, particularly St Petersburg, Riga, and Memel, with herring, dried fish, the woollen manufactures of Iceland and the Faroe islands, salt from France, Spain, and Portugal, the commodities of India and China, oysters, and dog-skin gloves. And they bring home potashes, planks, firewood, hemp, flax, cordage, iron, copper, and linen. The commerce with Germany is important. The Germans draw from this country a great number of horses, cattle fattened in the pastures of Marscheland, butter, cheese, fish, oil, woollen stockings, sugar, and tea; and give in exchange, thread, linen, wool, brandy, wines, ironmongery, paper, and books. The inhabitants of Sleswick, Holstein, and Norway, have long maintained an intimate commercial intercourse with the Dutch, from whom there is a great demand for rapeseed, wood, fish, &c.; and who give in return spices, medicines, seeds, tobacco-pipes, and paper. The commerce of England with the Danish states is chiefly with Norway, whence it imports a great quantity of wood. Most of the commercial towns of France are well acquainted with the Danish flag. The articles of exchange are, on the one side, butter, cheese, horses, fish, wood, and various Russian commodities; and, on the other, salt, wines, fruits, brandy, silk and woollen stuffs, and paper. Denmark exports for Spain and Portugal much the same articles as for France; and receives in return, salt, wines, dried fruits, and American goods. The Danish commerce in the Mediterranean, including the ports of France and Spain situated on that sea, employs a great number of ships. These vessels are laden outward with wood and fish from Norway, beef and butter from Holstein, and iron from Sweden; and they bring home wines, brandy, fruits, oils, and salt. The Danes derive great profit from hiring their vessels in the ports of Italy, where they are in great request, on account of the Danish flag being respected by the states of Barbary, with whom Denmark takes care to be at peace. The following Table shews the number of merchant vessels, above twenty tons, belonging to Denmark in 1799, as also their tonnage and their crews:

Shipping.

Places to which they belong.	Vessels.	Tonnage.	Crews.
Copenhagen	320	50,000	4,417
India Company	8	4,724	
Gr. Bailiwick of Zealand	52	4,526	175
Gr. Bailiwick of Funen	57	2,522	109
Laaland and Falster	14	460	40
Gr. Bailiwick of Aalborg	51	2,046	214
.... of Viborg	4	114	12
.... of Aarhuus	95	4,026	349
.... of Ripen	82	4,978	1,026
Sleswick	463	40,354	2,788
Holstein	290	38,842	3,434
	1426	150,980	12,564
Norway	747	98,940	6,336
Total	2183	249,938	18,900

In 1798, the number of vessels, foreign and Danish, which entered the port of Copenhagen, amounted to 5947. There has been at Copenhagen, ever since the year 1729, a maritime insurance company. The amount of the insurances in 1796 was 5,973,812 rix dollars; that of the premiums 273,272, and that of the payment of losses 304,459. At the end of the same year the capital of the company was 663,773; and at a general meeting of the proprietors, it was agreed that the divi-

Maritime Insurance Company.

Statistics. dends should be 4 per cent. In this country, no individual is allowed to insure ships. As the navigation of many ports on the coasts of the Baltic, the Categate, and the North Sea, is at some seasons extremely dangerous, all the maritime districts are provided with licensed pilots. Those of the island of Heligoland are particularly celebrated for their skill and intrepidity. Lighthouses have been erected in various places; and at Copenhagen a collection of charts has been made for the use of navigators. The foreign commerce of Denmark has been much affected by the late war with Great Britain. In several of its branches it has been considerably impeded, and in some of them altogether suspended; but the preceding statements refer chiefly to its customary extent and channels, to which it will now soon return.

Money. The common money of exchange in Denmark is the rix dollar, which is imaginary, or if there are any in currency they are but rare. The rix dollar is divided into 96 skillings, or into 6 marks of 16 skillings each. The rix dollar is worth about 4 livres 10 sols of France; 2 florins and 3 stivers currency of Holland; 12 or 13 copper dollars of Sweden; and 1 ruble of Russia. Four rix dollars are about the value of 5 rix dollars of Germany; and $5\frac{1}{6}$ the value of a pound sterling. The only gold money coined at present in Denmark is the ducat of two rix dollars. The silver coinage are pieces of 24, of 15, of 10, of 8, of 4, and of 2 skillings.

CHAP. V.

Government, Laws, &c.

Ancient form of government. THE government of Denmark, like that of most of the Gothic nations, was originally an elective monarchy. The right of election was vested in the three estates of the kingdom, the nobles, the clergy and the commons, who were to choose for their prince a man whose person was unexceptionable, who was valiant, just, merciful, affable, prudent, a maintainer of the laws, a lover of the people, an encourager of merit, in a word, adorned with all the accomplishments and virtues necessary for the execution of so important a trust. And though due regard to the royal line was always observed, and the crown almost uniformly conferred on the eldest son, yet was the new prince generally constrained to purchase his succession to the throne by the grant of farther immunities to the subject. The supreme legislative authority resided also in the three estates, assembled in a diet by means of representatives; the executive power was vested in the king and senate, composed of the principal nobles. The king was little more than president of the senate, and commander of the army, the royal prerogative being circumscribed by the charter of rights, always ratified by the sovereign at his accession. Such was the constitution of Denmark until the year 1660, when, by one of the most singular revolutions recorded in history, from being an elective, and one of the most limited monarchies in Europe, it became entirely hereditary, and one of the most absolute upon earth; exhibiting an unparalleled instance of a people spontaneously renouncing their freedom, and investing their limited governor, almost without his concurrence, with unbounded authority. This extraordinary event (the particulars of which will be found under the head of the history of this country) was brought about by the clergy and commons, for the purpose of punishing the insolence and oppression of the nobility. After a violent altercation with that order in the diet, on the subject of taxes, these two estates proceeded in a body to the court, made a full surrender of all their privileges into the hands of the king, and proffered him absolute sovereignty. The nobles, confounded by this unexpected proceeding, and unable either to resist or escape, were compelled to feign compliance with this deed of the other estates. Accordingly, on the 16th of October, the three estates annulled, in the most solemn manner, the capitulation or charter signed by the king at his accession—absolved him from his engagements—cancelled all the limitations imposed on his sovereignty—and closed the whole by the public ceremony of doing homage, and of taking the new oath of allegiance. The revolution being thus accomplished, a new form of government was promulgated, under the title of the Royal Law of Denmark. It consists of forty articles, of which the following are the most remarkable: "The hereditary kings of Denmark and Norway shall be in effect, and ought to be esteemed by their subjects, the only supreme head on earth: they shall be above all human laws, and shall acknowledge, in all ecclesiastical and civil affairs, no higher power than God alone. The king shall enjoy the right of making and interpreting the laws, of abrogating, adding to, and dispensing with them. He may also annul all the laws which either he or his predecessors shall have made, excepting this royal law, which must remain irrevocable, and be considered as the fundamental law of the state. He has the power of declaring war, making peace, imposing taxes, and levying contributions of all sorts," &c. &c. Then follow the regulations for the order of succession—the regency in case of minority—for the majority of the king—for the maintenance, of the royal family;—and after enumerating all the possible prerogatives of regal uncircumscribed authority, as if sufficient had not yet been laid down, it is added, in the 20th article, "All that we have hitherto said of power, and eminence, and sovereignty, and if there is any thing further which has not been expressly specified, shall all be comprised in the following words: The king of Denmark and Norway shall be the hereditary monarch, and endued with the highest authority; insomuch, that all that can be said and written to the advantage of a Christian, hereditary, and absolute king, shall be extended, under the most favourable interpretation, to the hereditary king or queen of Denmark and Norway," &c. &c. Thus securely did Frederic III. fortify himself in the full possession of absolute power, now that it was within his grasp, though, when first offered, he seemed to hesitate about accepting the gift. The commons soon found, what they might have foreseen, that they had punished the nobles but had not benefited themselves. Strange infatuation! that they should find no means of humbling their oppressors, and securing their own immunities, but the establishment of an absolute government. Though the king divested the nobility of many of the prerogatives they had before enjoyed, and annexed them to those of the crown, yet did he take no methods to relieve the people, who had been the instruments of investing him with the sovereign power, but left them in the same state of slavery in which they were before, and in which they have remained almost to the present day. Justice, however, compels us to state, that few absolute princes have less abused their unlimited authority than the kings of Denmark; and that, in this country, the rigours of a despotic monarchy have generally been softened by the mild and just administration of the sovereigns who have since filled the Danish throne. Uncertain, however, must ever be the condition of a people, whose happiness depends on the mere will or caprice of a single individual.

Present form of government. Royal law of Denmark. Statistics.

Administration.

The king of Denmark is assisted in the exercise of his royal functions by a privy council, composed of such persons as he may judge most deserving of his confidence, and whom he nominates and dismisses at his pleasure. The great officers of the state are generally members of the council, and the prince royal and the other princes of the blood sit in it by right. It is here that laws are proposed, discussed, and receive the royal sanction, and that all the important affairs of government are transacted.

Government offices.

The business is prepared in the different colleges or chambers to which it more immediately belongs, and through which all applications to the council must come.

Chancery of Denmark and Norway.

These different offices of government are, first, the *Chancery of Denmark and Norway*, which was established in 1660. Its jurisdiction, at first very extensive, has been gradually circumscribed. At present the interpretation of the laws, ordonances, and rescripts, belong to it. Its authority also extends to the public education, to ecclesiastical matters, and to the poor's laws. In it are drawn up all edicts and patents, dispensations, grants, letters of nobility, of legitimacy, and of naturalization, safe-conducts, and passports into foreign countries. The archives of the state are also kept in this chancery. Of late it has been divided into several chambers, having each its separate department.

German chancery.

2d, The *Chancery of Germany*, detached from the former in 1688, and having the same jurisdiction with regard to the provinces of Sleswick and Holstein. 3. The Office of Foreign Affairs.

College of revenue.

4th, The College or Chamber of Revenue. To this chamber, which formerly had the superintendance of the whole revenue of the state, at present belongs the collection of imposts, the management of the royal estates, the direction of the territorial police, and of that of the forests and highways. Confiscations, fines, the royal lottery, and all donations to the public revenue, are also within its jurisdiction. It has also the general superintendance of the mines, and of all matters connected with the internal and commercial administration of Iceland, the Faroe islands, and Greenland.

Chamber of customs.

5th, The Chamber of Customs, established in 1760, whose province it is to collect the revenue arising from the customs and tolls throughout Denmark, Norway, and the Duchies; to superintend the inferior agents, and examine their accounts. The Chamber of Customs has besides, the direction of all matters relating to the Danish American islands and possessions on the coast of Guinea.

College of finances.

6th, The College of Finances, established in 1771. It makes up the state of the revenue and expenditure, and brings forward such representations and proposals concerning them, as circumstances may require. It has also the management of the public money.

College of commerce.

7th, The College of General Economy and of Commerce. This college, whose jurisdiction extends to every thing connected with national industry, is divided into four offices, having each their separate province.

War office.

8th, The War Office. This office has the direction of the army in Denmark and of the Duchies. There is a separate office for Norway.

Admiralty office.

9th, The Admiralty Office. This office issues all the appointments and orders for the navy, and directs every thing connected with maritime affairs. Besides these offices established in the seat of government, there are various inferior ones for particular objects, in different parts of Denmark and Norway, connected directly or indirectly with the supreme authorities. The number of individuals of all ranks employed in the colleges and other offices of administration, amounts to about four hundred.

Provinces. Stifts-ampts, &c.

Denmark and Norway are divided into eleven provinces, or grand bailiwicks, called *Stifts-ampts*, of which there are three in the islands, four in Jutland, and four in Norway. Each of these provinces is governed by a Stifts-ampts-man, a post corresponding to that of Lord Lieutenant in Britain, or of Intendant in France, to which last it approaches the nearest. The Stifts-ampts are subdivided into districts or bailiwicks, called *ampts*, under the superintendance of inferior governors, called *ampts-men*. The Duchies of Sleswick and Holstein have a Governor-general, who resides in the castle of Gottorp. The cantons of Eystersted and Ditmarsen, the Lordship of Pinneberg, and the county of Rantzau, form likewise distinct governments; and the city of Altona also has a separate governor with the name of President.

Policy of the court in the disposal of public offices.

Ever since the revolution in 1660, the court of Denmark had been disposed to employ in the public offices of the state foreigners, especially Germans and persons of humble rank and fortune, in preference to natives and the ancient and more wealthy nobility. The nobles were sufficiently ambitious of procuring employments under government, which indeed is necessary for protecting their estates from the exorbitant exactions of the public collectors. But foreign adventurers, and men of low condition, were more convenient and pliant tools of the minister or favourite. This policy, the source of so much discontent and oppression, government solemnly renounced, by the publication of a law on the 1st of January, 1776, according to which, none but natives of the Danish states were to be admissible into public offices and employments, excepting in the case of such extraordinary merit as might justify the exception. This law, which was declared to be a fundamental law of the kingdom, was received with universal applause.

Royal establishment.

The court of Denmark was formed by Christian V. on the model of that of Louis XIV. which he had seen during his travels in France. The principal establishments are still retained, but on a much less expensive footing. Indeed, an attention to economy pervades all the departments of the Danish government. There are stated days for levees and the grand galas of the court.

Royal palaces.

The king's guard consists of several companies of infantry and troops of cavalry; and the chief ensigns of majesty at this court are of a military kind.

Frederic's place.

The chief residence of the Danish court is Frederic's Place, in Copenhagen, which was purchased for the royal accommodation after the burning of the vast and magnificent palace of Christiansburg, which the Danish system of economy has hitherto prevented from being rebuilt.

Rosenberg.

There is also in the capital the palace of Rosenberg, built by Christian the Fourth, which has not been inhabited of a long time. There are also, in different parts of the country, castles and villas belonging to the royal family.

Fredericsborg.

Fredericsborg, about eighteen miles from Copenhagen, the principal building of which is a magnificent edifice.

Fredensborg.

Fredensborg, or the Castle of Peace, so named because there the peace was signed with Sweden in 1720. It is situated in a delightful country, about eight miles from Cronberg.

Marienburg.

Marienburg, a villa situated on a height overhanging Cronberg, and commanding a beautiful view.

Hirscholm.

Hirscholm, fourteen miles from Copenhagen, in a very unfavourable situation, in building and embellishing of which Christian the Sixth expended very large sums of money.

Jaegersprus.

Jaegersprus, about thirty miles from the capital, in the gardens of which palace monuments have been erected to the illustrious men of the country;

Fredericsberg.

and *Fredericsberg*, built on an eminence in the neighbourhood of Copenhagen, which is the usual summer residence of the king and royal family. The kings of Denmark, in their public deeds, take the following title: " N. N.

Statistics.

Titles of the king of Denmark.

by the grace of God king of Denmark and Norway, of the Goths and Vandals, duke of Sleswick and Holstein, of Stormarn, and of Ditmarsch, count of Oldenburg and of Delmenhorst." The king's oldest son takes the title of Prince Royal, and the other children that of hereditary prince or princess.

Arms.

The arms of Denmark and Norway are three lions. To these are added separate arms for the duchies; and three crowns, which are also in the arms of Sweden, having been assumed by the sovereigns of both countries ever since the union of Calmar.

Degrees of nobility in Denmark;

The degrees of nobility in Denmark are two; those of counts or earls, and barons. The counts are entitled, illustrious and high lord; the barons, illustrious lord. The counts have the privilege of erecting canopies of state, and their eldest sons enjoy the title of barons. The number of earldoms or counties in Denmark and Norway is about seventeen, and of baronies fifteen. Besides those nobles who derive their nobility from their estates, which are royal fiefs, there are other families invested with the same titles, simply as personal distinctions.

In Sleswick and Holstein.

The nobility of Sleswick and Holstein form a distinct body, and enjoy more extensive privileges. Every thing connected with the common interests of this body is discussed in a general convention, held at stated times in the city of Kiel, when very disagreeable debates frequently take place. There are in Denmark two orders of knighthood; the order of the elephant, and the order of Danbrog. Of these, the first is considered as the most honourable, and conferred only on persons of the highest distinction and merit.

Gradations of rank.

The inhabitants of Denmark may, therefore, be divided, according to their rank, into the five following classes: 1st, The nobility who have privileged fiefs in the kingdom. 2dly, The titular nobility; to which class belong the companions of the two orders of kighthood—those counts and barons who are not possessed of counties and baronies—and the persons filling the higher offices of the state, whether civil, military, or ecclesiastical; all of which confer on those who hold them a certain nobility during their lives: and it is very common in this country to obtain, merely for the purpose of acquiring rank, the title of an employment which the person never exercises, and from which he derives no emolument, but for which, on the contrary, he often pays a considerable yearly sum. 3dly, The inferior clergy, lawyers, and students. 4thly, The merchants and citizens of the great towns: And, 5thly, The seamen and farmers.

CHAP. VI.

Laws.

Laws.

The laws of Denmark are remarkable for their equity, plainness, and brevity. They are expressed with so much precision, and so little subject to ambiguity, that almost the meanest capacity may comprehend them: The natural consequence of which is, that in this country lawsuits are rare, the number of lawyers is small, and the legal profession by no means lucrative.

General character.

The Danes boast not a little, and that not without reason, of their superiority in this respect to the most refined and learned people of Europe. It is asserted, however, that, notwithstanding of the excellency of their laws, it is difficult for the poor to obtain justice against the nobility and the favourites of the court.

Danish code.

The present code of Danish laws was published by Christiern the Fifth, and is founded on the code of Valdemar. It is comprised in one quarto volume, written in the language of the country, and divided into six books. The first book treats of the procedure of the courts of justice; the second, of the ecclesiastical government; the third, of offices and the different states of persons; the fourth, of the maritime laws; the fifth, of the different means of acquiring property, and of contract; and the sixth, of crimes and their punishments.

Courts of law.

With regard to the courts of justice, there are three gradations in Denmark:—First, The *Herredfogds*, which are the lowest and most circumscribed, similar in their nature to the English leetcourts.

Inferior courts.

These are established in the various districts throughout the country; are composed of a judge and a clerk, and meet once in the week. Corresponding to the Herredfogds in the country districts, are the *Byefogds* in towns and cities. Next, and superior to these, is the *Landstag*, or provincial court; of which there are five in Denmark, those of Zealand, Fionia, Jutland, Bornholm, and Falster. To these, which meet every month, there lies an appeal from the Herredfogds and Byefogds; which appeal must be taken within the space of half a year.

Supreme court.

The supreme court of the Danish dominions, called *Hight-right*, is held at Copenhagen. Here all causes are determined in the last resort, and the nobility have the privilege of being amenable to it alone.

The king nominally presides.

The king opens this court in person every year, with great solemnity, and delivers to the judges what instructions he thinks necessary. He is supposed to preside in it at all times; and a throne is erected for him, to which the lawyers address themselves in their pleadings, and the judges in giving their opinions.

Terms.

This court sits the whole year, with the exception of the months of July, August, September, and the half of February. This is the only court of justice in which verbal pleadings are allowed, the processes in all the inferior courts being conducted in writing. No appeals are received by this court, if not taken within a year and six months. The judges, who have fixed and adequate salaries, are some of them nobles, and some of them commoners. Their decision is final in all causes relating to the fortunes of the subject; but in such as regard their honour or their lives, the king has reserved the right of revision.

Forms of procedure.

An action at common law, commences by the plaintiff citing the defendant before the proper tribunal.

Civil causes.

This he is at liberty to do, either by word of mouth before two witnesses, or in writing. The claims of the parties, written in clear and concise terms, are then laid before the judge, who, besides, may put to them such questions as he apprehends will tend to an elucidation of the subject in dispute. After having fully heard the proofs on both sides, the judge solemnly pronounces sentence. Few causes occupy more than one sitting in either the supreme or inferior courts; and none can be extended beyond six weeks. The clerks and registers, too, are obliged to bring the whole process within a limited number of sheets, including the allegations, proofs, and sentence. A certain price is affixed to each sheet, and thus the parties may know to a certainty the utmost expence of a proceeding. When an appeal is brought before a superior court, the inferior judge is likewise summoned to appear and defend his decision, and he is sometimes obliged to render satisfaction to the party injured by an unjust sentence.

Criminal cases.

Criminal cases are conducted much in the same form as those of a civil nature. The judge, within whose jurisdiction the crime has been committed, empowers

Statistics. two lawyers to manage the cause; one to make proof of the accusation, and the other to act in behalf of the accused. If, however, the prisoner refuse the assistance provided for him, he is indulged with counsel of his own chusing. No criminal is condemned but on the testimony of sufficient witnesses. After condemnation, the privilege of appealing to the provincial, and from thence to the supreme court, is allowed to all who insist upon it. If the punishment extend to the loss of life, the judgment of none of the courts can be final, but, as has been already stated, a report must be made to the king himself in council, without whose approbation no sentence of death can be carried into execution.

Torture. The Danish law admits of the shocking practice of torture in two cases, after the accused has been fairly and lawfully convicted, and sentenced to lose his life: These are, the cases of murder and high treason. The intention of the law, by this permission, is to draw from convicts a discovery of their accomplices. But a statement of the case must be laid before the sovereign and his ministers for their consideration, and a warrant, signed by the king himself, must be obtained, before any proceedings of this merciless kind can take place; and it is but justice to state, that this cruel practice is very seldom resorted to, more than twenty years sometimes elapsing without the occurrence of a single instance. The law on this head was, however, shamefully violated in the case of the unfortunate minister Count Struensee, who, before his trial, was compelled, by the dread of the torture, to confess himself guilty of criminal intercourse with the queen. The iniquity of the proceedings on this occasion, will long remain a stain, if not on the Danish name, at least on the characters of the ruling party at that period. It is to be regretted, that the excellency of the Danish laws can be so easily rendered unavailing by the dispensations of the court.

Trial by jury. In cases of murder, and also for ascertaining the limits of estates and property in land, the law of Denmark allows of the trial by jury. The jurors, eight in number, must be men of good character, and in nearly the same condition of life with that of the person whose judges they are constituted. Besides this resemblance between the Danish and the British jurisprudence, there is another instance of similitude, which appears rather more singular, when we consider the political principles on which the present constitution of Denmark is erected.

Imprisonment. This is that excellent law, according to which no individual can be imprisoned unless he is seized in the act of committing a crime deserving of death or of bodily punishment; or unless he has acknowledged himself guilty before the proper magistrate; or been convicted in a court of judicature. In virtue of this law, individuals lying under an accusation have, till it is lawfully proved against them, on finding security for their appearance, a right of enjoying their personal freedom. In whatever country so valuable a privilege is allowed to subsist, the inhabitants may justly boast of possessing no small share of liberty; and if the Danes have, as they assert, preserved this law inviolate, and in its full force, they are a much freer people than they are generally represented, or than the subjects of an absolute monarchy could be supposed to have been.

Special courts. Besides these general courts of law, there are several others instituted for special objects. Such are the military tribunals of the two kingdoms, the tribunals of the mines, the various tribunals of commerce, and the tribunal of inquisition at Copenhagen for the discovery of robberies and thefts.

Commissions. Causes are often taken out of ordinary courts, and tried by commissioners appointed for the purpose. In these cases, one of the parties is generally a man of influence, who obtains such an appointment with some sinister view.

Courts of conciliation. Very great advantages have resulted from the tribunals of conciliation, established in 1795. If these tribunals succeed in reconciling the parties, the agreement is registered, and it has then the same validity as the sentence of a court of law; but if they fail in this object, the proceedings are to be regarded as never having taken place; no record is made, and no expences are incurred. The second chapter of the Danish code, treats of the ecclesiastical government, which shall be considered under the head of Religion.

Of the different states of persons. With regard to the third chapter, the state and privileges of the nobility have already been mentioned, and it remains only to notice the condition in which the Danish law considers the lower classes.

Condition of the peasants. These, with the exception of the inhabitants of the towns and cities, and a few of the peasants who had acquired their freedom, were, until lately, regarded as the property of the nobles, were attached to their estates which they could not leave, and were bought and sold with the soil. For a long time past, men of benevolence and enlightened views were convinced, not only of the injustice and inhumanity, but also of the impolicy of this state of things;

Edict for their emancipation. and several of the nobility, encouraged by the example of the royal family, had already emancipated their peasants, of which praise-worthy conduct they reaped the reward, not only in the gratitude of these hitherto degraded men, but also in the improvement of their estates. At length, this important object was universally and finally accomplished by the publication of an edict in 1788, ordaining the gradual abolition of the servitude of the peasantry; and all the inhabitants of Denmark were free on the 1st day of January, 1800.

Obelisk to commemorate this great event. To preserve the remembrance of this emancipation, an obelisk has been erected in the neighbourhood of Copenhagen, on the Roschild road, which is the most frequented by the peasants coming to the capital, on which is written the following words: "The king knows, that civil liberty, regulated by just laws, produces the love of one's country, and courage to defend it; the desire of instruction, a disposition for industry, and the prospect of happiness. He has therefore ordained, that servitude shall cease, and that order and promptitude shall regulate the execution of the rural laws, to the end, that the free, courageous, enlightened, industrious, and virtuous peasant may become a valuable and happy citizen." The base of the obelisk is adorned with emblems and inscriptions, and supports four marble figures, representing fidelity, rural industry, courage, and patriotism. The prince royal laid with his own hands the first stone in 1792. The inscription denominates him, "Son of the king and friend of the people." This monument, 48 feet in height, cost 14,000 rix-dollars, raised by subscription. The traveller, in stopping to contemplate it, will bless the names of the prince, of the minister, and of the individuals who, in spite of prejudice and of self-interest, accomplished so beneficial a reformation.

Cap. 4. of the Danish code. The fourth chapter of the Danish code, relates to contracts, and the different means of acquiring property.

Marriage. Marriages are regulated here in nearly the same manner as in other Lutheran countries. A divorce may be obtained in the case of adultery, of wilful desertion, or of impotence existing previous to the conjugal union. Amongst the nobles and persons of privileged rank, nothing more is necessary to constitute marriage than a simple consent in the presence of witnesses. The in-

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ferior orders must be married by a clergyman. Man and wife have all their goods and property in common, and any convention, contrary to this regulation, will be null, unless confirmed by the king. The survivor inherits the half of their joint fortunes; the other half is divided among the children, of which the said survivor shall, moreover, take a child's portion, but in case of a second marriage, this must be restored to the children. The women of this country are always under guardianship. When married, their husbands are their guardians; when unmarried, or widows, their nearest relation. They never attain majority but by dispensation.

Contracts.

Contracts drawn up in the presence of two witnesses, and signed by the contracting parties, are binding. Verbal bargains, in the hearing of witnesses, are likewise legal. Deeds, transferring hereditable property, must be registered.

Successions.

In Denmark, no person can succeed to the property of another, but by the path which the civil law points out, except the king, by a particular privilege, confers the power of making a testament. This permission, it is said, is seldom refused when there are no children, but when there is issue it cannot be granted. It is lawful, however, for husband and wife, who have no children, to dispose of the half of their property as they choose, and even of the whole, if it be for pious uses. Children succeed to the fortunes of their parents in the following manner: a son has double the portion of a daughter, and can take in preference any manor or freehold in the succession. The grandsons are admitted by right of representation, which indeed extends to all the descendants. If there are no descendants, the father succeeds alone. In default of the father, the mother succeeds conjointly with the brothers and sisters, and their posterity; afterwards the ascendants and collateral lines are admitted. The law makes no distinction from which side the property comes, but admits the paternal and maternal line to partake equally of the succession, preferring always those who are in the nearest degree. Any person having an estate in freehold lands of 2400 acres, may fix it by a special entail in his family, in what manner and on what conditions he shall think proper. The proprietors of freehold lands have the power of giving to one of their sons double the portion of the others, and if they have no sons, they may make the same regulation with regard to their daughters. Illegitimate children are treated with more humanity by the laws of this country than by those of most others. If the father acknowledges them before the legal tribunals, they obtain half the portion of the legitimate children, if he has any; and if he has none, they succeed to his whole property.

Of crimes and punishments.

The mode of procedure before the criminal courts has already been stated. The criminal code of this country is, in general, distinguished by its wisdom and its humanity.

Irreligion.

The laws enacted in a bigotted age, against apostacy from the established religion, heresy, sacrilege, profanation of holy days, and negligence in attending public worship, have here, as elsewhere, been greatly relaxed by the progress of toleration.

Treason.

The crime of treason has been regarded in a more heinous point of view since the monarchy was rendered absolute and hereditary. The principal article of the Danish law on this head runs thus: Whoever shall accuse the king and queen, with a view to dishonour them, or make any attempt on their life, or on that of their children, shall forfeit his honour, his life, and his property. Before execution, his right hand shall be cut off, his body shall be quartered and exposed on the highway, and his head and hand hung upon a gibbet. If the criminal is noble or of high rank, his arms shall be broken by the hangman, and his children degraded from the rank of nobility. Murder is punished with death, and the criminal is beheaded. Child-murder is not excepted, but the punishment is almost always commuted.

Robbery, theft, &c.

Robbery, housebreaking, theft, and other crimes of this nature, which, in other countries, are punished with death or banishment, are here punished by imprisonment or condemnation to hard labour for a limited time, or for the remainder of their lives. But if these criminals make their escape, and repeat their guilt, their lives are forfeited. The more heinous crimes, as treason, murder, robbery, &c. are seldom heard of, and capital punishments are rarely inflicted.

Maritime laws.

The following are some of the most important of the maritime laws of Denmark: No contracts between the proprietors of vessels and their captains are binding, unless they are in writing. Sailors are to be treated according to the agreement entered into with them. But captains may leave such as are seditious, even in foreign countries, and may confine those guilty of crimes or misconduct until their return. But he is required to do this only with the advice of the ship's counsel, or of some of the most respectable of the crew. If the person engaged as a pilot, shall occasion the loss of the ship by his want of skill, he is held liable to pay the damage; and if he be unable to do this, he is punishable with death. The means employed, however, by government for the instruction of seafaring people, render it seldom or never necessary to resort to this almost only rigorous statute of the Danish code. When a captain of a merchant ship is on a voyage in any foreign country, and is in want of money, he is authorised by the law to sell any part of the cargo entrusted to him for the supply of his wants. With the view of making the interests of seamen subordinate to those of commerce in general, the legislature has given to the captain of a vessel, in many instances, the power of breaking his contracts with his men. If, for example, he has engaged them to go a voyage to the Mediterranean, and afterwards finds he can sell her cargo to much greater advantage in the West Indies, they are obliged to make that voyage along with him. In former times, all ships driven ashore on the Danish coast, were immediately robbed and plundered; and even the nobility and Romish bishops, whose lands were situated on the sea-shore, drew from this barbarous custom a considerable revenue. In abolishing this savage practice, the kings of Denmark have experienced the strongest opposition; and the attempt cost Christian the Second his crown and his liberty. The following are the enactments at present in force with regard to shipwrecks: The shipwrecked goods must be deposited by the inhabitants of the coast, in a place of security, and no person can oblige the captain to sell them. Whoever shall carry off the effects of a ship which has been wrecked, to the value of 50 marcs, shall be hanged as a felon. Shipwrecked effects unclaimed at the end of a year and a day, after paying the expence of salvage, belong one half to the king, and the other to the person having the right of escheat in the district. On the subject of insurances and other matters of this nature, the Danish code is conformable to the principles adopted by all commercial nations.

Laws of Sleswick and Holstein.

The duchies of Sleswick and Holstein have preserved their own ssparate institutions and laws; and the administration of justice is much more complicated in them than in the Danish states.

Sleswick.

The laws of Sleswick are contained in the ancient code of Jutland, published by

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Valdemar II. in 1240. It is easy to perceive, however, that these laws must have been subjected to many alterations in modern times. Several districts and cities have laws of their own, as Heligoland, Femern, Eystersted, Brested, Husum, and Fredericstadt. The laws of Holstein are contained in several voluminous collections, and consist of a number of charters, ordonances, and rescripts, which have appeared at different periods. They acknowledge the Roman law in some instances, and the decrees of the diet of the empire have also some authority. The police of Denmark is in general the same as that of the other countries of Europe. It embraces many useful regulations, and is by no means of that inquisitorial description which is commonly found under arbitrary governments. The details will be given under the descriptions of the cities.

Holstein.

Police.

CHAP. VII.

Finances.

Finances. Revenue. Demesnes.

The revenue of the kings of Denmark arise from the following sources. From the royal demesnes, which, before the revolution, formed their only income. These have since been portioned out to different proprietors for the advantages of agricultural improvements, and the quit-rents still produce a considerable revenue. From the tithes in Denmark and Norway, which, since the Reformation, the king has divided with the clergy. The king's share of the tithes of Denmark have been sold to ten individuals. From licences for the distillation of spirits, from the mint, from grants and dispensations, from licences for hunting and shooting on the royal estates, from lotteries, from the toll on the Sound, &c. In 1770, the toll of the Sound produced 459,890 rix dollars; and since that time it must have produced yearly, at an average, at least half a million. Besides these, which are considered as more peculiarly the rights of the crown, the necessities of the state have imposed various other taxes. Of these, the land-tax is one of the most considerable. This tax is levied, according to a valuation, even originally, in many respects objectionable, made in the reign of Christian the Fifth. The standard employed in this valuation was the Danish measure of the ton of *Hartkorn*, which is such an extent of land as would sow three tons of grain, one of rye, one of barley, and one of oats. The quantity varies of course according to the quality of the soil, but the ton of Hartkorn may be considered, on an average, about six English acres. The pasture grounds, woods, and mills, are likewise estimated by this measure. The land tax per ton of Hartkorn, is for the arable and pasture grounds, one rix dollar, forty-two skillings, and for the woods and mills, one rix dollar, eighteen skillings, amounting to about one shilling and eightpence sterling per English acre. The lands of the nobility are exempted from this tax. The privileged lands throughout all Denmark was, in 1786, estimated at 55,377 tons, and those subject to the tax, at 316,100. Besides the above, the possessors of land are subjected to another tax, called the corn-tax, paid partly in money, and partly in kind, which amounts to about one rix dollar, one marc, four skillings per ton for the arable and pasture grounds, and to three marcs ten skillings for the woods and mills. In 1800, in the assessment for the following year, the price to be paid for the grain was fixed by government, and the privileged lands, and even those of the counts and barons, were also taxed, and at the same rate with the others. The valuation of the duchies was made in 1657. Some districts have been valued more recently, and are taxed by the plough, which is nearly equivalent to nine tons of Hartkorn. All estates are subject to the tax, and pay between three and four rix dollars per plough monthly. A poll-tax has long been levied in the Danish dominions. Formerly the inhabitants of the country only were subjected to it; but in 1762, it was extended, without distinction, also to those of the cities and towns. Every individual above twelve years of age, pays one rix dollar. The children of peasants who are farmers, and those of day-labourers, do not pay this tax until they have completed their sixteenth year. This tax has been abolished in Norway and another substituted in its place, the peasants having considered it as a badge of slavery. The towns of Altona and Bornholm are also exempted from it on the payment of an annual compensation. The tax formerly levied on marriages, was very properly suppressed in 1792. It still exists in Copenhagen as a city-tax. A tax on ranks was introduced in 1764, and laid in the following proportions.

Tithes, &c.

Toll of the Sound.

Land-tax in Denmark.

Statistics.

In the duchies.

Poll-tax.

Marriage-tax.

Tax on ranks.

1st class taxed at	80 rix dollars per annum.
2	70
3	40
4	24
5	18
6	15
7	12
8	8
9	6

Widows pay the half of this tax, with the exception of those whose annuity is below a hundred rix dollars. In 1768, a tax was laid on all places and pensions according to the following gradation:

Tax on places and pensions.

Incomes of	100 rix dollars to	150 taxed at	2 per cent.
	150	200	3
	200	250	4
	250	300	5
	300	350	6
	350	400	7
	400	450	8
	450	500	9
	500 and upwards		20

The clergy were at first taxed at 10 per cent. on their incomes of every description; but since 1770, they have been rated in the same proportions as the civil and military officers. All collateral successions have been taxed at 4 per cent. since 1792. The stamp duties were introduced by Frederic the Third in 1657. All the proceedings of the courts of justice, commissions, letters patent for all public employments and titles: All kinds of contracts, conventions, obligations, receipts, and all public acts, must be written on stamped paper. The lowest stamp for bonds, &c. is two shillings, and the highest for all pecuniary bargains is ten pounds sterling. The smallest receipt stamp is two-pence, and the highest L. 2, 8s. The patent for creating a count with a county, must be written on a stamp of the value of L. 60; for a baron with a barony, L. 40. The commissions of all the great officers of the crown and state, of the first class, must be written on a stamp of L. 20, of the second class L. 16; thus diminishing with the rank and class until the lowest is only sixteen shillings. The customs and excise form one of the most productive branches of the public revenue. This department is regulated on principles similar to those established in other commercial states. The expence of

Stamp duties.

Customs.

Statistics. Collectors, &c. collecting the taxes is by no means great. In the cities and towns, the chief magistrate superintends the collection. In the country, collectors are appointed, of which there are thirty-three for Denmark, forty-one for Norway, and thirty-one for the duchies. The officers of the customs amount to fifty-five in Copenhagen, two hundred and thirty-five for the rest of Denmark, two hundred and forty-four for Norway, and ninty-nine for the duchies. Amount of public revenues at different periods. In 1699, there passed into the public treasure of the states nearly 3,500,000 rix dollars; in 1726, nearly as much; in 1756, 4,955,800; in 1770, 6,081,830; from 1785 to 1787, about 7,270,172. The following Table exhibits the particulars of this last receipt.

Table of the receipt in 1787.

Denmark Proper.

Denmark.

	Rixdollars.	Sk.
Land-tax	609,019	76
. . . . . .	190,143	9
. . . . . .	45,517	57
Tax on articles of consumption in the country	65,005	63
Stamp-duty on cards	5,624	72
Stamped paper	121,973	73
Capitation-tax, and tax on ranks	466,957	29
Four per cent. on capitals	121,913	29
Income-tax on places and pensions	65,602	42
Revenue of the royal demesnes	19,119	15
Customs	522,856	15
Custom on tobacco and salt	32,496	29
Custom on hopes	10,645	7
Tax on articles of consumption in the cities, &c.	610,145	63
Interest of the capital secured on the royal estates which have been sold	7,193	8
Total	2,892,213	15

Norway.

Norway.

	Rixdollars.	Sk.
Land-tax	281,042	76
. . . . . .	41,571	38
Tithes of corn and of fish	20,682	3
. . . . of iron	4,616	64
. . . . and other taxes on copper	49,309	95
. . . . of fish and excise at Bergen	13,693	42
Tax on articles of consumption in the country	11,521	38
Stamp-duty on cards	4,066	64
Stamp paper	54,418	54
Tax on ranks	13,304	94
Four per cent. &c.	20,334	19
Tax on places and pensions	16,070	6
Customs	472,778	21
Custom on salts and tobacco	34,871	1
Tax on articles of consumption in cities	100,580	43
Custom on hopes	1,368	48
Total	1,140,230	14

Duchies of Sleswick and Holstein.

Duchies.

	Rixdollars.	Sk.
Land-tax	452,365	52
. . . . . .	458,987	72
Rents of the royal demesnes	226,352	7
Corn and forage tax	73,367	21
Carry forward	1,211,072	56
Brought forward	1,211,072	56
Stamped paper	49,608	5
Tax on capital and on ranks	260,078	65
Four per cent, &c.	48,575	0
Tax on places and pensions	14,472	31
Particular revenues of the district of Glocksburg and of Ditmarsch	26,384	0
Revenues of the district of Kiel	725	53
Contributions of the Jews in Altona	3,000	0
Customs	129,934	64
Custom of tobacco and of salt	27,287	79
. . . . . of hopes	2,495	22
Total	1,777,626	42

Various other Revenues.

Various other revenues.

	Rixdollars.	Sk.
Toll of the Sound	581,779	91
Lotteries	134,353	94
. . . . . .	15,552	32
Revenue of the bank	335,441	70
Revenues not specified	70,427	73
Revenue of the American islands	112,868	69
Commissions, &c. to the colleges or chambers	103,996	61
Lighthouse of Lindesnæs	4,233	0
Quarries of Segeberg	5,132	65
Revenue of the royal forests	82,284	20
Commerce and contributions of the Faroe islands	5,778	68
Commerce of Iceland	7,280	0
Total	1,460,102	30

	Rixdollars.	Sk.
Denmark	2,892,213	15
Norway	1,140,230	14
Duchies	1,777,626	42
Various revenues	1,460,102	30
Total	7,270,172	5

Expenditure. Such was the amount of the whole revenue of Denmark in 1785, 7,270,172 rix dollars 5 skillings, or about £1,400,000 sterling. Since that period it has been increased in all the Danish states, particularly in Norway, and may now amount to upwards of a million and a half. The court establishments, the royal household, the civil list, the army, and navy, form the principal objects of the ordinary expenditure; the amount of which, in 1770, was nearly 6,158,710 rix dollars—in 1786, 7,579,734—and in 1790, 6,525,000. The items of this last year, which is about the average of the ordinary expences of the Danish government, was, exclusive of some small sums for particular purposes, as under:

	Rix dollars.
Court and royal household	250,000
Establishments of the prince and princess	180,000
Civil list	707,500
Extraordinary bounties	111,000
Pensions and ordinary bounties	120,000
Army	2,080,000
Navy	1,200,000
East India possessions	180,000
Carry over	4,828,500

Statistics.

	Rix dollars.
Brought forward	4,828,500
Bounties for the encouragement of commerce, mines, and manufactures	300,000
Annuities	27,000
Buildings and repairs	120,000
Interest of the national debt	1,100,000
Sinking fund	150,000
Total	6,525,000
or	L. 1,262,903

National debt.

The national debt in 1758 amounted to 4,250,250 rix dollars. In 1771, it was at home 7,139,762 rix dollars, and abroad 10,051,184, making in all 17,190,946. A system of stricter economy was introduced into all the public departments of the state in 1785, and at the same time means were taken for rendering the revenue more productive. The public debt has, in consequence, been considerably reduced, though no doubt the disturbances in Europe which have since taken place, have much retarded the plans of liquidation adopted by the Danish government.

CHAP. VIII.

Military and Naval Establishments.

Army. Regulars. Militia.

Army.—The forces of Denmark consist of regular troops and of militia. The number of the former varies according to circumstances, and is composed partly of natives and partly of foreigners, chiefly Germans. Formerly every person who possessed 360 acres of land was obliged to furnish one man for the militia, and to pay half the expence of a man for the corps of reserve. In 1788 this faulty system was abolished, and the militia is now raised in the following manner. Every peasant at his birth is enrolled in the militia lists. The age during which they are liable to be called upon to serve, is from twenty-one to thirty-six; and when vacancies take place, the oldest on the roll of the district must supply them. The term of a militiaman's engagement is eight years, and before the expiration of that period, he cannot quit his district without leave from the constituted authorities. The militia of this country are not formed into separate regiments, but are attached to the regiments of the line. They are occasionally exercised in small bodies on Sundays and holidays, and are embodied once every year, at which time they join their respective regiments. In Denmark and the duchies, this annual service continues about a month, and in Norway twelve days. The clothing of the Danish army is furnished by an extensive manufactory established by government for this purpose. The prevailing uniform is red. The regulars are clothed every three years, the militia only every twelve. The troops of the line are paid according to the following scale:

Pay of the troops.

A colonel	1740 rix dollars per annum.
Lieutenant-colonel	852
First captain	600
Second captain	228
First lieutenant	156
Second lieutenant	133
Ensign	114
Serjeant	18 skillings per day.
Corporal	12
Private	6

A militiaman has five rix dollars yearly, besides two skillings per Danish mile (4½ English) when marching to the station of his regiment, and the pay of a soldier while he remains there. The regular troops are stationed in the cities and fortresses, and lodged at the expence of the citizens. The horses of the regular cavalry are maintained partly at the expence of government, and partly by the farmers. The army is supplied with officers from the Academy of Land Cadets, instituted by Frederic the Fourth, where seventy-four cadets are instructed in the military sciences at the royal expence. The whole military force of Denmark, in 1796, was as follows:

Cavalry.	
In Denmark and the duchies	6,066
In Norway	4,349
	10,415
Infantry.	
In Denmark and the duchies	30,396
In Norway	30,509
	60,905
Corps of engineers	35
Corps of artillery	3,299
Total	74,654

Of the above, 50,880 are militia, 7808 being cavalry, and the remainder infantry. In 1801, a new militia was raised, called *the defence of the country,* and composed of all those who had served in the ordinary militia, and who had not attained the age of forty-five. Denmark possesses strong natural ramparts. The most important fortifications are those of Copenhagen, of Fredericia in Jutland, of Rendsburg, and Gluckstadt in Holstein, and of Fredericshall, Fredericstadt, Aggerhuus, and Fredericswærn in Norway.

Navy.

Navy. The Danes, from their insular situation, have long excelled as a maritime people, and are still the most numerous, as well as the most experienced, sailors of any of the kingdoms on the Baltic. In the beginning of the year 1801, the Danish navy consisted of 22 ships of the line fit for service, and seven which were dismasted; of 15 frigates, four brigs, 13 gun-boats, and three praams, besides several vessels on the stocks. Since the above period, this naval force has been greatly reduced, or almost entirely annihilated, first by the victory of Lord Nelson, and afterwards by the seizure of their whole fleet by a British armament in the month of August 1807. A considerable time must elapse before Denmark can again appear powerful at sea. The building and refitting of the ships of the Danish navy is intrusted to a particular board appointed for that purpose, to whose examination all plans and models are submitted. The greater part of the oak employed in the naval arsenals is procured from Germany, by contract with the king of Prussia. Holstein produces oaks, but not in sufficient quantity, and they are preserved for cases of extreme necessity. All the cannon, shot, anchors, and iron work are cast in Norway. Flax, hemp, and masts, are procured from Russia, and pitch and tar from Sweden. The Danes have manufactories of cordage and sails, but they do not yield sufficient for the use of the fleet. The remainder is procured from Russia and Holland. The principal station of the Danish navy is the harbour of Copenhagen, which lies within the fortifications. Four or five ships of the line

Statistics.

are generally stationed in the ports of Norway, a frigate off Elsineur, another off the isle of Funen, and a smaller vessel in the Elbe. The number of registered seamen is 14,600, divided into two classes; the first comprises those furnished by the maritime districts, who are allowed to engage in the service of merchant ships trading to any part of the world. Each receives two rix-dollars annually from the crown, and is subject to recal in case of war. The second comprehends the fixed sailors, who are constantly in the employ of the crown, and amount to about 4000, which are divided into 40 companies, and are stationed at Copenhagen for the ordinary service of the navy and the work of the dock-yard. When not at sea, they receive each two rix-dollars per month, besides flour and other provisions; every two years a complete suit of clothes, and every year breeches, stockings, shoes, and a cap. When they sail, their pay is augmented to five rix-dollars per month. The marine artillery consists of 800 men in four divisions. A ship of 90 guns, with its full complement, carries 850 men, of 70 guns 700, of 64 guns 600, of 50 guns 450, and a frigate of 36 guns 250. The chief nursery for naval officers is the Academy of Marine Cadets, instituted by Frederic IV. in 1701. The foundation is for 60 cadets, who are maintained and instructed in the theory of navigation at the expence of the crown. Beside the original number, other youths are admitted under the name of volunteers, at their own expence. Every year they make a cruise on board a frigate.

Seamen.

Academy of marine cadets.

CHAP. IX.

Population.

Population.

The population of Denmark, previous to the last century, is altogether uncertain. In 1720, government appointed registers to be kept of the births, deaths, and marriages; but it was not until 1775, that these could be consulted with any degree of confidence. An enumeration of the inhabitants of all the Danish states in Europe was made in 1769, of which the result was 2,017,127 souls. But it ought to be observed, that the army and navy were not included in this enumeration, and that it took place in summer, when many individuals, and particularly seafaring people, are absent from their homes. Besides, the fear of its being only the forerunner of some new tax, induced many to avoid it. The following Table of births and deaths exhibits the progress of population in the Danish states from 1785 to 1799.

Years.	Births.	Deaths.
1785	64,920	68,691
1786	66,123	65,759
1787	64,033	61,901
1788	68,382	61,308
1789	68,134	61,299
1790	67,919	57,006
1791	70,131	56,105
1792	75,597	56,150
1793	72,368	56,752
1794	73,246	57,906
1795	71,562	57,746
1796	71,617	55,520
1797	76,468	58,202
1798	77,750	60,884
1799	77,284	59,878

The following Table proves the number of marriages also to be increasing.

Years.	Marriages.	Years.	Marriages.
1777	14,189	1797	20,930
1795	18,712	1798	21,050
1796	19,600	1799	18,267

The present population of the Danish dominions is estimated at two millions and a half; and though there is reason to think that it considerably exceeds that number, it is yet by no means adequate to the natural resources of the country. Denmark enjoys a salubrious and temperate climate, a soil by no means unfruitful, and a situation favourable to commercial industry. But under what latitude, or on what soil, could population keep pace with the intentions of nature, when that class of the inhabitants, who ought to cultivate the earth and raise the means of subsistence, are reduced to that state of servitude and degradation in which the Danish peasants have been so long held. To this prominent obstruction, are to be added several others, such as the laws imposing restraints on industry and commerce, the tax on marriages, the public burdens bearing so heavy on a great part of the community, and the faulty administration of the poor's laws. These obstacles have now in a great measure been removed, and the population has already felt the effects in the most striking manner.

CHAP. X.

Religion.

Religion.

Until the ninth century, the Danes, as well as the other Scandinavian nations, were professors of the religion of Odin, the celebrated conqueror, legislator, and prophet of the North. About this period, Christianity was introduced into Denmark by St Augarius, bishop of Hamburgh and Bremen, in the reign of Harold Clachius, the first Christian monarch. The principles of the Reformation found their way into this country at an early period, and notwithstanding all the efforts of the Catholic clergy to stop their progress, Lutheranism was formally established in 1536. The government of the Lutheran church of Denmark appears to form a medium between the English hierarchy and the discipline of the Calvinistic church. The Bishops, who act only as superintendants, have no temporal jurisdiction. Their authority extends no farther than is necessary for maintaining good order and decency in the church, and advancing the interests of religion. They confer the sacred orders, inspect the conduct of the clergy, whom they exhort, reprove, or even suspend, as circumstances require, examine the state of the schools, inquire into the management of the poor's funds, &c. within their diocese, which they ought to visit at least once in three years. Every diocese is divided into a certain number of districts, in each of which there is an archdeacon, who represents the bishop in his absence, and exercises all his functions. These archdeacons are elected by the votes of the ministers of the several parishes of the district. Twice a year a general assembly is held of the archdeacons of the diocese in which the bishop presides, and which is also attended by the grand bailiff or Stifts-amptsman on the part of the king. These assemblies take cogni-

Statistics.

sance of all ecclesiastical matters in the diocese, and hear appeals from the judgments of the archdeacons. There lies an appeal from the sentences of these assemblies to the supreme tribunal of the kingdom, which judges of all cases, both ecclesiastical and civil, in the last instance. In ecclesiastical causes, two bishops have seats in this court. Besides the diocesan assemblies and the archdeacons courts, there is, in every parish, an assembly composed of the elders of the church, and the rector or minister, who is the president, whose province it is to watch over the manners of the people, and to correct those disorders which the laws do not punish. There are altogether in the Danish states, thirteen bishops, two hundred and twenty-seven archdeacons, two thousand two hundred and sixty-seven parochial clergy, and one hundred and ninety-five chaplains. There are in Denmark no archbishops, but the bishop of Zealand, who is first in rank, and the bishop of Aggerhuus, are metropolitans. The revenues of the clergy arise chiefly from tythes, glebes, surplus fees, and the voluntary offerings of the parishioners at the chief festivals. The bishops have an income of from 400 to upwards of 1000 pounds sterling. In Denmark, the parochial livings seldom exceed L. 400 or fall short of L. 60 per annum, Jutland excepted, in which peninsula there are some not worth L. 20. In Norway, the highest may be rated at L. 200, and the lowest at L. 60. In Iceland, some parishes do not produce more than L. 3 or L. 4 a year. A clergyman's widow receives the whole profit of her husband's cure for the year immediately following his decease, and a pension from his successor amounting to the eight of his annual income. There is also in every diocese a fund for the widows of ecclesiastics, from which they draw annuities proportioned to the rates paid into it by their husbands. The church livings are in the gift of the king, of the possessors of the privileged estates, and sometimes of private individuals. A few are in the nomination of the parishes themselves. The ministers of the established church of Denmark are deservedly held in high estimation; and in no reformed country do they possess greater influence over the people. To this they are probably in a good measure indebted to the practice of confession still retained in this church, and to which all, even those of the highest rank, must submit. In the pulpit too, they assume the authority of the ministers of Christ, and reprove with great freedom men of the first quality, who practise public vices; nor are any liberties consistent with the duties of their function ever taken amiss. It was not until towards the middle of the last century, that any other than the established religion was tolerated in the Danish states. But liberty of conscience is now recognised, and the greater part of the penalties imposed on non-conformists are either rescinded or softened. In the reign of Frederic the Fourth, a society was established at Copenhagen, denominated the *College for the propagation of the Gospel.* This society, whose funds are derived from the bounty of the king and other contributions, extends its labours, and often with the happiest effects, to Lapland, Greenland, and Asia.

Religion.

College for propagating religion.

CHAP. XI.

Literary Establishments, &c.

Education.

By the laudable exertions of government, and of benevolent individuals, the means of education are placed within the reach of all classes in the Danish states. Besides numerous private and charitable institutions for this purpose, every parish is provided with one or two schools, where children are instructed in the reading and writing of their native language, and in arithmetic. The schoolmasters have, in general, a salary of about £12 per annum, a house, and a few other advantages. And at Copenhagen, and some other places, institutions are established for the purpose of forming teachers to fill the parish schools. In these institutions they are instructed in the necessary branches of education; and, at the same time, in a school which is attached to the seminary, they exercise the art of teaching under the eyes of the professors. They are furnished by the institution with lodging, fire, and candles. In applications for admission, the sons of schoolmasters are preferred. Besides the ordinary parish schools, there are various Latin schools in the different parts of the country, maintained at the expence of the crown: 19 in Denmark Proper; 4 in Norway; 11 in Sleswick; 16 in Holstein; and 2 in Iceland. In these schools, besides Latin, are taught history, geography, Greek, and Hebrew. The salaries of the teachers vary from £60 to £200.

Parish schools.

Latin schools.

The constitution of these seminaries, founded in an unenlightened age, requires many corrections. At Odensee is a college, or gymnasium, with four professors, who teach rhetoric, theology, philosophy, mathematics, and Greek and Hebrew. The famous academy of Soroe is now fallen into complete decay. The great public seminary of education in Denmark is the university of Copenhagen, which was founded in 1479 by Christian the First, and has been augmented and amply endowed by his successors. It possesses a very considerable fund, and the professors have liberal salaries. It has a library of about 60,000 volumes—a chemical laboratory—a cabinet of natural history—a botanic garden—and an anatomical theatre. The number of the students is generally about 700, who come not only from Denmark, but also from Norway and Iceland. There is another university in the city of Kiel, in Holstein, also well endowed, having twenty ordinary professors, with salaries of about 1500 rix dollars. This university has likewise a good library—a botanic garden—an observatory—and an anatomical theatre. The number of students is, at an average, about 200.

College of Odensee.

University of Copenhagen.

Of Kiel.

The Royal Academy of Sciences was founded in 1742, and owes its institution to the zeal of six literati, whom Christian the Sixth ordered to arrange his cabinet of medals. These persons occasionally meeting for that purpose, extended their designs, associated others who were eminent in several branches of science, and, forming a literary society, employed themselves in examining and explaining the history and antiquities of their country. At the recommendation of the count of Holstein, Christian took it under his protection, called it the Royal Academy of Sciences, endowed it with a fund, and ordered the members to join to their other pursuits natural history, physics, and mathematics. In consequence of the royal favour, the members engaged with fresh zeal in their pursuits; and the academy published many volumes of transactions in the Danish language, some of which have been translated into Latin. About the same period, a society for the improvement of northern history and languages was instituted by a few persons, at the head of whom was Langebek, since greatly distinguished for his historical publications. Many new members being admitted, Christian the

Literary institutions.

Royal academy of Sciences.

Statistics. Sixth, with his usual zeal for letters, constituted it, in 1746, a Royal Society. It has proved itself not unworthy the royal protection, having given to the world several publications which tend to throw considerable light on the annals of Denmark. The Academy of the Fine Arts was founded in 1754 by Frederic the Fifth. This academy consists of a president, a director, eight professors of painting, sculpture, and architecture, and four teachers of design, and a secretary. The pupils will sometimes amount to 800, and are all taught gratis. A Commission of Antiquities has also been established, which has published two volumes of its Transactions, under the title of *Antiquarian Annals, published by the Royal Society in Copenhagen for the Preservation of Antiquities;* one of which appeared in 1812, and the other in 1813.

Literature, &c. The literature of Denmark cannot aspire to much antiquity, having followed, as usual in other European countries, the introduction of Christianity. In the 12th century flourished the historian Saxo Grammaticus, whose History of Denmark abounds, indeed, with fable, but whose style is remarkably classical for that age. His cotemporary, or predecessor, Sveno, is more authentic and concise, and is esteemed the father of Danish history. In astronomy, Denmark has to boast of Tycho Brahe, one of the most celebrated names in that department of science. The Danish literati have particularly turned their researches to the history and antiquities of the north. Among those who have greatly distinguished themselves in this branch of learning, must be mentioned the names of Maersius, Holberg, Olaus Wormius, Pontopidan; and more lately, those of Langebek, Schoening, and Suhm. The Danes have been by no means deficient in the study of natural history. The *Flora Danica*, begun by Oeder under the royal auspices, in 1762, and afterwards conducted by Muller, is one of the most magnificent and valuable works of the kind. And the collection of rare shells, in two volumes folio, engraved and coloured by Regenfuss, at the king's expence, is the most splendid work of that description ever produced by any nation. In 1761, Frederic the Fifth, with a view of extending the bounds of knowledge, sent four persons, eminently versed in different branches of science, to Arabia; of which curious and interesting journey, Niebuhr, the only survivor, has published a much esteemed account.

CHAP. XII.

Language, Manners, Customs, &c.

Language. The language of Denmark is a dialect of the Teutonic, but French and High Dutch are spoken at court; and the English is also very generally learned amongst the higher classes. In their persons, the Danes are, in general, tall and robust; their features and complexion are good; and their hair of a flaxen, yellow, or red colour. The women are said to be rather clumsy in their shape, and awkward in their dress. The food of the lower classes consists chiefly of oat cakes, rye bread, fish, cheese, &c. But the tables of persons of condition are plentifully covered with every luxury. Drunkenness and excess are the vices to which the Danes are most addicted. Manners, &c. The character and manners of the inhabitants of every country depend much on the nature of the government; and those of the Danes have undergone successive changes, corresponding with the changes in their political situation. Before the government was made hereditary and absolute, the nobility and gentry lived in great splendour and affluence. Their country-seats were magnificent, and their hospitality unbounded; and when the states were annually assembled, they met their sovereign with retinues as numerous and brilliant as his own. Now they are fallen from that height of insolence and power; their condition is low, and they diminish daily in number and credit. Molesworth affirms, that in his time their estates scarcely paid the taxes imposed on them, which obliged them to grind the faces of their poor tenants, to get an overplus for their own subsistence. The common people, he says, are a poor mean-spirited dastardly race, totally degenerated from the warlike disposition of their ancestors; equally addicted to fraud themselves, and suspicious of it in others. Lord Molesworth, it is probable, has taken the most unfavourable view of the Danish character; but there is no doubt it has been altered much for the worse by the revolution, which converted their free government into a despotic monarchy. The ameliorations, however, which their patriotic sovereigns have for a long time past been gradually introducing, have produced a sensible improvement on the Danish character. Extravagance of every kind is still a very general disposition of the Danes. The peasantry are poor and dirty; but the superior ranks differ little from those of the same class in the other countries of Europe. See *Mod. Univ. Hist.* vol. xxxii. Busching's *Historical and Geographical Magazine.* Molesworth's *Account of Denmark.* Roger's *Lettres sur le Danmarc* 1764—1768. Wraxall's *Tour.* Andrews' *History of the Revolution of Denmark, with an Account of the Present State of the Kingdom and People.* William's *Rise, Progress, and Present State of the Northern Governments.* Coxe's *Travels Tableau des Etats Danois,* par Catteau. *Tableau de la Mer Baltic,* par Catteau, &c. Milburn's *Oriental Commerce,* vol. i. (*θ*)

Density ‖ Dentition. DENSITY. See Astronomy, Atmosphere, Hydrodynamics, and Mechanics.

DENTARIA, a genus of plants of the class Tetradynamia, and order Siliquosæ. See Botany, p. 263.

DENTELLA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 146.

DENTIDIA, a genus of plants of the class Didynamia, and order Gymnospermia. See Botany, p. 256.

DENTITION. See Surgery, and Teeth.

Denys. DENYS, St, *Sanctus Dionysius,* an ancient town of France, in the department of the Seine, is situated on the banks of the Crould, on an agreeable and fertile plain near the Seine. This town rose into notice, in consequence of the celebrated abbey of Benedictines of the congregation of St Maur, which was founded over the tomb, and in honour of St Denys and his companions, by King Clothar, A. D. 600. This abbey was successively improved by the kings Dagobert, Pepin, Charlemagne, and Charles the Bald. The church, which was completed A. D. 1181, is a fine Gothic building, of the finest freestone, and covered with lead, and is greatly admired for the lightness of its architecture. Its treasury was, under the dynasty of the Bourbons, considered the richest in Christendom. This abbey has been the burying-place of the kings of France and of the royal family; and it contained, before the revolution, many splendid monuments; among which was that of Charles V. and his Queen, Charles VIII. Louis XII. and his Queen, Francis I. and his family, Henry II. with his wife and children; Bertrand du Guesclin, constable of France; and the Marshal Turenne, whose ashes Louis XIV. wished to be mixed with those of kings. These splendid monuments, however, were in a great measure destroyed and carried away during the anti-regal fanaticism which prevailed during the French revolution. The ashes and bones of the kings were impiously scattered in the air; and a few fragments of the monuments which covered them, were preserved by the antiquarian zeal of M. le Noir, and are now in the National Museum. The monastery is a very fine modern edifice.

Since the Emperor Napoleon ascended the French throne, he has endeavoured to expiate the sins of the revolutionists, by repairing and embellishing the church. Two of the windows have been ornamented with the finest painted glass. Between two expiatory altars in the nave, one for the Merovingian, and another for the Carlovingian race, is a column which is to be hung with the portraits of the six French monarchs who were emperors. An expiatory altar for the third dynasty of the Capets is placed on the left side of the nave. The principal altar is placed in the centre; and the stair cases which lead to the choirs are of marble. Napoleon has also restored the vaults which contained the royal monuments, and has defended it with a massy gate of gilt brass.

A number of curiosities, both sacred and profane, are preserved in this town; but particularly the vase of Oriental agate, which represents a feast celebrated in honour of Bacchus, and which is reckoned one of the finest, as well as one of the most valuable articles of the kind. Several manufactures are carried on in St Denys, particularly refining of sugar, and a manufactory of Indian stuffs. Not far from the town, on the road to Epinay, is an extensive bleaching establishment. Population 4425. Distance north of Paris, 6 miles. See Reichard's *Guide des Voyageurs en France*, Weimar, 1810; and *Coup d' oeil Historique sur la ville et l'eglise de St Denis avec le Plan*, Paris 1802. (*w*)

DEPTFORD, a large and populous town of England, in the neighbourhood of London, and in the county of Kent. It is situated on the banks of the Thames, at the mouth of the small river Ravensbourne, which is here navigable for lighters and small craft, and which is crossed by a good stone bridge. The town, which is divided into the Upper and the Lower town, is very irregularly built, but contains many good modern houses and shops. The principal edifices in the town are the two churches and the naval buildings, to which it owes all its importance. The church of St Nicholas consists of a nave, chancel, and aisles, and has an embattled tower of stone and flint, much older than the body of the church itself. The old church had been enlarged about the year 1630, and the body of the present fabric was rebuilt in 1697. It contains numerous monuments, the principal of which are those of Captain Fenton, Henry Roger Boyle, George Shelvocke, Esq. Sir Richard Browne, Mr John Benbow, &c. The church of St Paul is a handsome stone building, which was erected before the year 1730. It has a good spire at the west end, and consists of a nave, chancel, and aisles. The roof is sustained by Corinthian columns, and the inside is neatly fitted up. The principal monuments are erected to Admiral Sayer, and Matthew Finch, Esq. The rectory house is a handsome building. The Old Hospital, which was rebuilt in 1788, contains 25 apartments. The Trinity Hospital, which was erected in 1672, forms a spacious quadrangle, containing fifty-six apartments. A statue of Captain Richard Maples, who, in 1680, bequeathed L.1300 to the hospital, stands in the centre of the quadrangle. The pensioners in both these hospitals, are old sailors and masters of ships, and their widows. There are also in Deptford several valuable establishments for the education of the poor.

The principal naval buildings are, the royal dock or king's yard, the victualling office, and the private docks. The king's yard includes about thirty-one acres, which are covered with various buildings, and it contains a double and a single wet dock, three slips for men of war, a basin, two mast-ponds, a model loft, mast houses, a smith's shop, with nearly 20 forges for the manufacture of anchors. The old store-house is a quadrangular pile of building. The range on the north side bears the date of 1513, and those on the other sides have been built at different times, a double front having been added towards the north in 1721. Some years ago another store-house was built parallel to the old one, and a range of smaller store-houses were erected in 1780. The victualling office, or red house, has been erected at different times since the year 1749, and consists of houses for the principal and inferior offices, granaries, bake-houses, slaughtering-houses, houses for curing beef, brew-house, and a wind-mill for grinding corn. A kind of earthen ware, called Deptford ware, is manufactured here to a great extent.

The following is an abstract of the population return for 1811 for the town of Deptford.

Number of inhabited houses	3,463
Number of families that occupy them	5,010
Number of houses building	97
Number of houses uninhabited	59
Families employed in agriculture	208
Families employed in trade and manufactures	3,413
Families not included in these classes	1,389
Males	9,526
Females	10,307
Total population in 1811	19,833
Total population in 1801	17,548
Increase since 1801	2,285

See Hasted's *History of Kent*; and Brayley's *Beauties of England and Wales*, vol. vii. p. 456—469. (*π*)

DERBENT, Derbund, or Derbend, a city of Persia, in the province of Daghestan, of which we have already given a full account under the article Daghestan.

DERBY, a town of England, and capital of the county of the same name, is situated in a valley, extending and opening as it advances southward, into a fine and well cultivated plain. It stands on the western banks of the river Derwent, on ground a little elevated above the level of the surrounding vale; its situation is, therefore, very pleasant; and the scenery in its environs extremely beautiful.

Antiquarians do not agree in the derivation of the

Derby.

name *Derby*. Historians inform us, that during the Heptarchy the Saxons called it *Northworthig*; but of this appellation, not a trace now remains. In the time of the Danes, it was called *Dearaby*; a word, said to be compounded of two Saxon ones, signifying a habitation for deer; but this derivation is too fanciful to admit of any credit. The most probable conjecture is, that the name of the town, and that of the river *Derwent*, have the same origin; that originally it was *Derwentby*, or the town by the Derwent; and, that in process of time, this name was corrupted, or abbreviated into *Deorby* and *Derby*.

From the contiguity of Derby to the Roman city *Derventio*, now called *Little Chester*, it is supposed that it must be a place of some antiquity, and of some consequence prior to the Roman invasion; for the Romans generally fixed their stations in the vicinity of some British town. But in what age, or by what nation it was founded, it is impossible to determine.

Antiquities.

There are but few antiquities in Derby. Formerly there stood a castle near the south-east corner of the town, but there have been no remains of it in the memory of any person living. About twenty years ago, an antiquarian took some pains to search out its site. He discovered some vestiges of it, near what is called Castle-hill, in an orchard: it was guarded by the Derwent on one side, and on the other runs, at present, the London road. It is the opinion that Derby castle was built about the reign of Stephen; and that it was destroyed during the civil wars between the houses of York and Lancaster.

Religious houses.

We are informed by ancient authors, that there were six religious houses in the town of Derby; several of which were in existence at the suppression of the orders by Henry VIII. The monastery of St Helen's, belonging to the order of Austin Friars, was situated on the spot where the spar manufactory now stands, near the upper end of Bridge-gate. It was erected in the reign of Stephen, by Robert de Ferrers, second Earl of Derby. But in the reign of Henry II. the abbot and canons removed to Darley, a beautiful spot, about a mile from the town, situated on the banks of the Derwent. A priory of Dominican, or Black friars, once stood on the spot where the mansion and grounds of M. Henley, Esq. now stand, in the Friar-gate. It is thought to have been founded in very early times; and was dedicated to the blessed Virgin. On the north-west side of Nun's-green, in the meadow that was called Nun's-close, stood a priory of Benedictine nuns, dedicated to St Mary de Pratis. It was founded by the abbot of Darley, in the year 1160. Near the brook, on the north of St Jances' lane, stood a cell of Cluniac monks. It was of Saxon origin, and founded by Waltheof, a nobleman of that nation, who was beheaded by William the Conqueror in the year 1074. He dedicated it to St Jances, and presented to the Abbey of Bermondsey, in Southwark. A Mansion de Dieu, a hospital for leprous persons, was founded in Derby, as early as the reign of Henry II. There was also here, an old hospital of royal foundation, consisting of a master and several leprous brethren, dedicated to St Leonard. St Mary's was an old building in the Saxon style, situated upon the verge of the Derwent, and forming a part of the old bridge. It is thought to have been one of the six churches mentioned in Domesday-book.

Churches.

All Saints.

At present, Derby contains five churches, the principal of which, is All Saints. The tower of this church is much admired. It was built in the reign of Henry VIII. or of Mary; and is an elegant specimen of the Gothic architecture. The workmanship is of a superior kind, and reckoned excellent; it is richly ornamented, and rises to the height of 180 feet; towering above the churches and houses, it forms a beautiful and striking object from the surrounding country. Tradition says, that it was built at the expence of the bachelors and maidens of the town; but the opinion is merely conjectural. Between this tower and the body of the church, there exists an uncommon instance of architectural incongruity; for to this beautiful specimen of Gothic architecture, is added a Grecian body of the chastest proportions and most classical design. It was built from a design by Gibbs, in the years 1723-4-5. The expences of the erection were defrayed by voluntary subscriptions, which were raised and directed by Dr Hutchinson, who was then the curate. This worthy man, by indefatigable industry, raised nearly L.7000 by his own exertions in begging, and executed this masterly work without a shilling of expence to his parish. The interior of this church is large, light, and elegant; five columns on each side support the roof; the windows are large and handsome; and the symmetry and harmonious proportions of the building, have a pleasing effect. The church contains several monuments of the Cavendish family; and many persons of that illustrious house are buried here. The principal are the following: one erected to the memory of the famous Countess of Shrewsbury; another to William Earl of Devonshire; one by Rysbrack to the memory of Caroline of Besborough; and another by Nollekins, displaying the medallion and arms of her husband William Ponsonby, Earl of Besborough. The church contains a good organ, and the tower a set of good bells and chimes.

St Alkmund's.

St Alkmund's church stands at the north-east end of the town, and was erected about the middle of the eighth century. This, like All Saints, is in the gift of the corporation. The church of St Peter is situated near the southern extremity of the town, and is thought to be the same as the one mentioned in the time of king Stephen, dedicated to the same apostle. St Werburgh's is situated on the western side of the town, upon the Markeaton-brook. St Michael's stands in Queen-street. This living, is a vicarage united with St Werburgh. Besides the above mentioned churches, the Presbyterians, the Independents, the Baptists, the Quakers, the Roman Catholics, and the Methodists, have their respective places of worship in the town.

St Peter's.

St Werburgh's.

St Michael's.

Charitable institutions.

One of the most considerable charities in Derby, is the Devonshire Alms-houses, situated near All Saints. This was founded by the Countess of Shrewsbury, in the reign of Elizabeth, for eight men and four women. The rules for the observance of the inmates are, "that they are not to marry or get drunk, without expulsion; to lie one night out incurs a forfeiture of four-pence; if absent one day, six-pence; to miss prayers at All Saints, two-pence; to strike a blow, one shilling; and if three blows, a discharge." In the Bridge-gate there are eight alms-houses for an equal number of the poor and aged of both sexes. Another alms-house, for the widows of clergymen, is situated at the top of the Friar-gate. The inmates, who are five, receive L.17 a year each. For the education of the children of the poor, the free-school in St Peter's church-yard was originally intended, and has endowments to support two masters; but the only schools where the really poor are now admitted, are the Lancastrian and Bellian schools, which have lately been established by subscriptions raised in the town and neighbourhood.

The principal buildings in Derby are, a county and

Derby.

Coun-y hall. town-hall, a county gaol, an elegant assembly-room, a theatre, and an infirmary. The county-hall was erected in 1660, and is a large heavy building of stone. The town-hall is a handsome structure of brick, built by the corporation about the year 1731. The county gaol, is situated on the western side of the town, near the upper end of Friar-gate. It was erected in the year 1756, at the expence of the county, aided by a donation of L.400 presented by the Duke of Devonshire. It is a solid plain building of brick, well adapted for the purpose of its destination. The assembly-room is an elegant building of stone, situated in the market-place. Its erection was completed in 1774. The theatre is a neat building of brick, with an interior plain and commodious. It was erected by a private individual, in the year 1773.

Gaol. Assembly-room. Theatre.

General infirmary. The erection of the Derbyshire general infirmary,* was commenced in the spring of the year 1805, and the building was completed for the reception of patients on the 4th June, 1810.

The site of the building is at a short distance from the town of Derby, immediately adjoining the London road, from which it forms a very good object, greatly improving that entrance into the town.

The ground plan is a square, the side of which is about 100 feet. The sides are not in the same straight line. If we suppose each side divided into three equal portions, the middle portion of each side stands within the other portions about eight feet, so that the walls of the latter are distant eighty-four feet on each side, and the walls of the projecting portions one hundred feet. The floor of the basement story is three feet below the surface of the land on which the building is erected, and the second story eight feet and a half above the same. The entrance into the latter is by a right and left flight of steps terminating in a portico, after the model of the Parthenon on the Acropolis at Athens. This entrance is into a spacious hall, not less than 34 feet square. The apartments on this floor are, the board-room on the left side of the entrance, and the matron's room on the right. On the left side of the hall are the apothecary's rooms, the apothecary's shop, and the out-patients' room; the latter is also employed as the chapel. On the right side of the hall, are the physicians and surgeons rooms, and the porter's rooms.

From the centre of the hall, and facing the entrance, the stair case commences. It first rises to a landing, which is joined to the opposite wall; it then divides into a right and left flight of steps, which occupy one side of the hall, and lead each way to a gallery or balcony, projecting six feet within the hall, on the other three sides. From the centre of the front balcony, is the entrance into the operating room, which is directly over the entrance below. It is well lighted, and every way fitted for its intended purpose.

All the other rooms on the right and left are divided into wards of various sizes. The left side is for the males, and the right side for the females, each apartment on one side being precisely similar to that on the other.

Those wards nearest to the operating room are small, each containing one bed only. Others, adjacent, contain two beds. In the centre of these small wards is a small room, called the nurse's scullery. It contains a small stove and other conveniences. Adjacent to this is the nurse's bed-room. This part, which is on each side the same, is destined for acute diseases, in which the stilness and privacy afforded by this arrangement, are of great importance. The rest of the wards are larger, and contain more beds, as the cases require. On the same floor, on each side, is a spacious room, one for the males, the other for the females. These are called convalescent rooms. They are for the reception of all the patients who are not immediately confined to their bedrooms. This constitutes the third and last story.

Derby.

General infirmary.

The hall is lighted by a skylight, which forms a dome in the centre of the building. The rest of the roof, which covers the rooms, slopes towards the cornice on one side, and towards the dome on the other, the ridge being over the middle of the range of rooms on each side.

The dome is made of cast iron, put together in segments. On the centre is placed a round pedestal of stone, upon which stands a colossal figure of Esculapius, modelled in clay, by a Mr Coffee of this place.

A portion of the back part of the house, from the basement story upwards, is kept completely distinct from the rest, constituting fever wards. This part has in no respect whatever any communication with the rest of the house; and has, hitherto, been as successful in preventing the communication of contagion, as if it were at a greater distance.

The basement story contains the kitchen, the scullery, the wash-house, and the laundry. It has a separate entrance from the front, under the portico of the story above, on each side of which is a public bath, one being kept at the heat of Buxton water, and the other of that of Matlock. There are five spacious baths, elegantly fitted up, which bring a handsome income to the charity. They are heated by steam, which is brought in pipes from the boiler of a steam engine of one horse power, which is employed to pump water from a well below into a cistern at the top of the house, and to perform a variety of other offices connected with the economy of the establishment. The kitchen is a pattern for neatness and convenience. The fire place in it is not larger than to keep the room comfortably warm, and is not employed for any culinary purpose. The baking and roasting is performed by an oven on very superior principles, invented by Mr W. Strutt of this place. It is so contrived, that the greatest possible proportion of the heat is applied to the body contained in it, while no part of it comes into the room. The principal advantage, however, of this invention, consists in the heat being applied equally on every side of the substance at the same time, so that the door of the oven is never opened for the purpose of turning what may be contained in it.

Near to the roaster is a steaming apparatus, invented also by Mr Strutt, and applicable to all culinary purposes. A recess is made in the wall similar to that for stoves in common use. The bottom of this recess is formed by a flat piece of cast metal, capable of holding the number of dishes intended to be steamed. Round this, is a groove filled to a certain height with water. The whole is covered by an inverted vessel of tinned copper, in the form of a dish cover, the edges of which

* As we consider the Infirmary of Derby to be one of the most complete establishments of the kind in Europe, we have deviated from our general plan, in giving a very minute account of a building which reflects equal honour upon the liberality of the town, and the skill of the gentlemen under whose superintendence it was completed. Ed.

Derby.

General infirmary.

drop into the groove above mentioned. The steam is let in at the middle of the table or plate, and the condensed water runs off at an opening in the groove.

The boilers, in which the soup and milk pottage are made, have no fire places, being all heated with steam. The scullery is supplied with hot water from a large vessel, which, by the agency of steam, is kept always hot, and by another contrivance always full.

The most important part of this establishment is, the means of keeping that part of the house destined for the patients, at an uniform temperature throughout the year. This is effected by a current of warm air passing through the rooms in winter, and a supply of cool air during the hot months of the summer, accomplishing by the same means perfect ventilation, which is so essential to places of this description.

The air which passes through the rooms at all times, enters through a subterraneous channel, the opening to which from the atmosphere, is distant about 100 yards from the building. This channel, from its depth below the surface, is so near the mean temperature of the earth, that the air of winter is partially warmed, whilst that of summer is considerably cooled. In the greatest heat of summer at this place, the temperature of the air is lowered in its passage as much as 20° of Fahrenheit's scale. In winter, the same air, after it escapes from the channel, passes through a stove on very superior principles, the invention of the ingenious philosopher before mentioned. The fire is made to act upon the interior of an inverted dome-shaped vessel, constructed of iron, while cold air is plentifully supplied on the outside to carry off the heat given to it by the fire. This is effected in so complete a manner, that the largest fire which could be made under the dome would not heat it to redness, provided that the communication of the air to the room in which the stove is placed, remained uninterrupted.

The writer of this article is, at present, preparing a work for the public, in which, all the inventions connected with this establishment will be particularly described. It may be observed, in addition to the above, that in this infirmary, the wash-house and laundry are so contrived, that much manual labour is saved, and the utmost cleanliness insured. The principal part of the washing is performed by a machine which is turned by the steam engine. The drying is effected, in bad weather, by a stove, on principles similar to that used for warming the rooms. This also serves at any time for airing linen and beds.

In most infirmaries and hospitals, the construction of the water-closets in common use, is so extremely bad, as to be the occasion of great and deserved complaint. This inconvenience is entirely obviated here. It would be improper to enter into particulars of the construction of them in this place, but it may be stated generally, that they are so contrived, that the oftener they are used the less smell will be perceived. Every time the closet is entered, the whole of its contaminated air is changed for fresh air, and every source of nuisance at the same time washed away, independent of any care of the person who uses it.

Ordnance depot.

Not far from the Infirmary, and about the same distance from the town, is an ordnance depôt, erected by the Board of Ordnance in 1803, according to a plan by Mr Wyatt. It consists of an armory in the centre, calculated to contain 15,000 stand of arms. Above this is a room of the same proportions, containing accoutrements for the use of the army. On the north and south sides, are two magazines, capable of containing 1200 barrels of ammunition. Four dwellings are situated in the angles of the exterior wall; two of which are barracks, and the other two are the residences of officers in the civil department.

Trade.

Concerning the trade of Derby, old authors are nearly silent. It is thought, that the oldest carried on in the town was that of a dyer. Wool and malt were also among the articles of its early commerce. Trade was confined to these articles, until the commencement of the eighteenth century, when the stocking-frame machine was introduced into the town. This was a considerable addition to the commercial interests of the place; but what gave it a pre-eminence in this respect, was the erection of the first mill in this country for the manufacture of silk.

Silk mill.

This silk mill, the first and largest of the kind ever built in England, stands upon an island in the river Derwent, adjoining the town. At the commencement of the last century, a person of the name of Crotchet, erected a small mill near the present works, with the intention of introducing the Italian method of spinning into this country. About the year 1715, a similar plan was in the contemplation of a mechanic and draughtsman, named John Lombe, who travelled into Italy, to procure drawings, and models of the machines necessary for the undertaking. After remaining some time in that country, and gaining as much information as the jealousy and precautions of the merchants of Italy would allow, he returned with two natives, accustomed to the manufacture, into this country; and fixed upon Derby as a proper place to establish his works. He agreed with the corporation, for an island, or rather swamp, in the river 500 feet long, and fifty-two wide, at a rent of about eight pounds yearly. Here he established his silk mill: and in 1718 procured a patent to enable him to secure the profits for fourteen years. But Lombe did not live much longer; for the Italians, exasperated at the injury done to their trade, by its introduction into England, sent an artful woman over, who associated with the parties in the character of a friend; and having gained over one of the natives who had originally accompanied Mr Lombe, administered a poison to him, of which, it is said, he ultimately died. His death, however, did not prove fatal to his patriotic scheme; for his brother, and afterwards his cousin, carried on the business with energy, and employed more than 300 people. A little before the expiration of the patent, Sir Thomas Lombe petitioned for a renewal of it; but this was refused, and instead of it, £14,000 was granted him, on condition that he should suffer a complete model of the works to be taken: this was accordingly done, and afterwards deposited in the town for public inspection. The property now wholly belongs to the corporation. The present occupier employs about 240 hands.

This extensive mill stands upon huge piles of oak, double planked, and covered with stone work, on which are turned thirteen stone arches, which sustain the walls. Its length is 110 feet, its breadth 39; and its height 55 feet. It contains five stories: in the three upper, are the Italian winding engines, which are placed in a regular manner across the apartments, and furnished with many thousand swifts and spindles, and engines for working them. In the two lower rooms, are the spinning and twist mills, which are all of a circular form, and are turned by upright shafts passing through their centres, and communicating with shafts

Silk mill.

from the water-wheel. The spinning mills are eight in number, and give motion to upwards of 25,000 reel bobbins, and nearly 3000 star-wheels belonging to the reels. Each of the four twist mills, contains four rounds of spindles, about 389 of which are connected with each mill, as well as numerous reels, bobbins, star-wheels, &c. The whole of this elaborate machine, though distributed through so many apartments, is put in motion by a single water-wheel, twenty-three feet in diameter, situated on the west side of the building.

All the operations, from winding the raw silk to organizing or preparing it for the weavers, are performed here. The raw silk is chiefly brought in skains or hanks from China and Piedmont. The skain is first placed on a hexagonal wheel or swift, and the filaments which compose it are regularly wound off upon a small cylindrical block of wood, or bobbin. To wind a single skain, is the work of five or six days, though the machine be kept in motion for ten hours daily; so astonishingly fine are the filaments of which it is formed. The silk thus wound upon the bobbins, is afterwards twisted by other parts of the machinery, and is then sent to the doublers. Here four, seven, or ten threads are united into one, according to the uses for which it is designed: the fine kind going to the stocking-weavers; the others to different manufactures.

Besides this mill, there are several other works of a similar nature, now established in Derby; but of very superior machinery. Indeed, the old mill proves, at how low an ebb mechanical knowledge was in England as well as Italy, when that was constructed. The situation of Derby on the banks of the Derwent, renders it favourable for carrying on manufactures which require the aid of water. The mills established by the Messrs Strutts, for the manufacture of silk and cotton, are particularly ingenious in their machinery; and the facility attained by them in working the several articles of manufacture, has contributed to the extension of these branches of business, in a very eminent degree.

Cotton mills.

Porcelain manufactory.

The porcelain manufactory was established about the year 1750, by a gentleman of the name of Duesbury. Since his decease, very great improvements have been made, in the preparation of the materials, and in the appearance of the ware. It is thought to equal, in fineness of texture, the French and Saxon, while it far surpasses them in workmanship and elegance. The paintings are, in general, rich and well executed; and the gilding and burnishing very beautiful. The manufactory employs about 200 hands.

Another considerable manufactory carried on in this town, is that of gypsum, fluor-spar, and marble. These are formed into a great variety of very beautiful ornaments; and the Derbyshire marble is well known in almost every part of the kingdom, and much admired. The machinery which Messrs Brown and Son have invented for sawing and polishing this marble is exceedingly ingenious, and worthy of notice. The manufacture of stockings is carried on to a very great extent in Derby: it was here the rib-stocking frame was invented, and first worked. The business of the lapidary and jeweller is also of some magnitude here; and articles of the paste kind are executed with great elegance and ingenuity. The other manufactures, are bleaching, slitting and rolling iron, tin-plate, lead pipes, red and white lead works, and a shot tower.

Improvements.

Derby has rapidly increased within the last few years, in size and population; and is still increasing in wealth and commerce. Fresh ground is continually broken up, and houses are erected in every direction. Among the modern improvements in the place, may be mentioned, the lighting and paving the streets, the erection of several new bridges over the brook that runs through the town; and an elegant bridge of three arches, thrown over the Derwent, on the north-east side of the town.

Philosophical societies.

Dr Darwin, though not born, yet spent the last one-and-twenty years of his life at Derby; and by his residence there, diffused a taste for literature and science, which still continues to be one of the principal characteristics of the place. He was the patron and founder of an establishment known by the name of the *Derby Philosophical Society*, the objects of which were the promotion of scientific knowledge by the occasional meetings and convocation of its members, and by the circulation of books. The date of the formation of this institution was the year 1788, the first meeting being held at Dr Darwin's own house, when he was chosen president, and read to his associates a most appropriate and excellent introductory essay on the progress of human knowledge, which, it is to be regretted, has never met the public eye. He retained the chair of this society till his decease, since which time it has been ably occupied by his intimate friend, and disciple, Mr Strutt, of whose merits some mention will be found in another part of this article, and in some other parts of our work. The Philosophical Society still boasts a considerable number of members, and is in possession of an extensive and valuable library; but its utility, as a scientific body, has of late years, in a certain degree, declined. The want of some compulsory law, by which questions for conversation should be *regularly* furnished, has robbed the meetings of part of the interest which they originally possessed; and as a few of the more active members were anxious to enjoy all the advantages which such an association was capable of supplying, the idea of a new establishment was thence excited, in which subjects for discussion might be more strictly and constantly furnished. To have accomplished this under the auspices of the parent society was impossible, from the known unwillingness on the part of the majority of the members then composing it to consent to such a restraint. This gave rise to the foundation of a new and very flourishing institution, which made its appearance in the year 1808, under the title of the *Derby Literary and Philosophical Society*. The objects of this association, as stated in its printed rules, are "the pursuit of literary and scientific inquiries, and the improvement of its members in the power of gaining, and of communicating, knowledge." The means by which these objects are attempted to be accomplished, is by the production and discussion of papers, or essays, which may be written on any subject connected with literature or science, excluding only the *practical* departments of medicine and surgery, party politics and religion. It is a fundamental law of this society, that each member shall furnish an essay in his turn, and no instance has hitherto occurred in which this rule has been violated. The meetings are held monthly from September to April inclusively, one paper being read, and another discussed, on each evening. In addition to the above, the society had also adopted the plan of delivering annually a public course of lectures, the profits of which are applied to the purchase of philosophical apparatus. These have been attended with the most complete success, and the members who have employed their talents in this way have acquitted

Derbyshire.

themselves with great credit. Besides the two societies already mentioned, there are not less than eight or ten others, in this small town, formed for the circulation of books, one of which is confined to the purchase of French works exclusively.

Derby has weekly markets on a Wednesday and Friday, and seven annual fairs, which are generally very numerously attended. It is 126 miles north north-west of London, and is situated in Long. 1° 25′ W. and Lat. 52° 58′ N.

The following is an abstract of the population-return for 1811:

Inhabited houses	2,644
Families that occupy them	2,924
Families employed in trade and manufactures	2,382
Ditto in agriculture	95
Males	5,978
Females	7,065
Total population in 1811	13,043

See *Hatton and Davies' Histories of Derby.* (D. P. D.)

DERBYSHIRE, a midland county of England, situated about the centre of the kingdom; being at an equal distance from the German Ocean on the east, and St George's Channel on the west; and on the north and south, the extremities of Northumberland and Hants are nearly alike remote. On the north, it is bounded by Yorkshire, and a part of Cheshire, which is separated from it by the river Etherow; on the south, by a part of Leicestershire; on the east, by the county of Nottingham and another part of Leicestershire; and on the west, it is divided from Staffordshire and Cheshire by the Trent, the Dove, and the Goyt. It is included between the parallels of 52° 38′ and 53° 27′ North Lat. and between 1° 13′ and 2° 3′ 30″ West Long. It is the twentieth county in the order of magnitudes, and the nineteenth in the order of population.

Ancient state.

In the time of the Britons, Derbyshire is found included in the number of counties that made up the kingdom of the *Coritani;* but the Romans, when they gained possession of the island, made a new division of it, and Derbyshire made a part of *Flavia Cæsariensis.* Under the heptarchy, Derbyshire was included in the kingdom of *Mercia.* The figure of the county is so irregular, and its outlines so variable, that it can hardly be said to bear a resemblance to any determinate figure. It approaches nearer to that of a triangle than any other; but its numerous curves and projections make the resemblance more imaginary than real. Its greatest length, from north to south, is about 56 miles, and its breadth, at the northern extremity, 33; but from thence it gradually diminishes, so that at its southern extremity it narrows almost to a point. Its circumference is about 204 miles, containing about 972 square miles, or 622,080 statute acres, of which above 500,000 are cultivated, arable, and pasture, whilst the remainder consists chiefly of bleak mountainous regions, heaths, and open commons.

Civil division.

The civil division of Derbyshire is into six hundreds; the High Peak hundred, Scarsdale hundred, Wirksworth Wapentake Appletree hundred, Molleston hundred, and Reppington hundred. These are subdivided into parishes, (which are about 116) townships, and hamlets. The county contains 11 market towns; and the population (1811) amounted to 185,487, there being then 35,658 houses inhabited by 37,440 families. The county of Derby sends two members to parliament; a privilege which it enjoyed as early as the reign of Edward I. The assizes are held at Derby in the spring and autumn, and three of the quarter sessions are also held there, the other at the town of Chesterfield. With respect to the common judicature, Derbyshire is included in the midland circuit.

Ecclesiastical state.

In ecclesiastical concerns, Derbyshire forms a part of the diocese of Lichfield and Coventry, and is divided into six deaneries, High Peak, Ashbourn, Castillar, Chesterfield, Derby, and Reppington.

General aspect.

There is no other county in England which presents such a variety of scenery as Derbyshire; the northern and southern parts exhibiting such a striking difference and contrast in geographical features. The former abounds with hill and dale; and often the scenery is romantic and sublime. The country gradually rises for about 15 miles northward, and then more abruptly, and afterwards begins to assume that mountainous appearance, which it continues to possess to its extremity. A chain of hills arises, which extends to the borders of Scotland. They are at first of small elevation; but being in their progress piled on one another, they form very elevated ground in the tract called the High Peak. The most considerable, however, in height, are Axe Edge, 2100 feet higher than the level of Derby, and Kindu Scout, 1000 feet above the level of Buxton. The southern part of Derbyshire is a pleasant, fertile country, not distinguished in its appearance from the other midland counties. The banks of the Trent is a range of low meadows, for the most part well cultivated, but presenting no variety of scenery.

Rivers.

Like all other hilly countries, Derbyshire abounds in rivers. The principal are the Trent, the Derwent, the Dove, the Errewash, the Wye, and the Rother. The most considerable rivulets are the Bootle, the Amber, the Morledge, the Ecclesburn, the Bradford, and Lathkil, the Noe, the Ashop, the Schoo, the Dane, and the Goyte. This country also is not deficient in the advantages of navigable canals.

Canals.

The first that was opened was the Grand Trunk canal, leading from the river Trent to Wilden Ferry in Derbyshire. This was planned by Mr Brindley, about the year 1766. The Chesterfield canal, completed in 1776, cut from that place to Stockwith near Gainsborough, where it enters the Trent. The Langley Bridge, or Errewash canal, the act for which was obtained in 1777, is navigable from Langley bridge to the Trent. The Peak Forest, proceeding from the Ashton Under Line canal to the northern parts of Derbyshire, was finished in the year 1800. Cromford canal begins at Cromford, and joins the Errewash at Langley bridge. The Ashby-de-la-zouch was completed in 1799, and the Derby canal in 1794. These six are the only canals hitherto formed in Derbyshire.

Climate.

The atmosphere and climate of Derbyshire vary much in its different districts. From its northern situation, even the southern part of the county is colder, and more frequently visited by rains than many of the more central counties of England. Owing to the great elevation of the northern part, it is found much colder than the southern. Some grain will not ripen at all in the Peak. It is not uncommon to see oats out and uncut in October and even November. The winters, in general, are very severe; and the frost continues so long in the ground, that it cannot be broken up until the season is far advanced: the consequence is, that the corn has seldom sufficient time to ripen, and is cut down and left to wither in the sun and to be dried by

Derbyshire.

the air. It has been supposed, that the mountains of the Peak of Derbyshire attracted the clouds, and that this part of the county was distinguished by frequent and heavy rains; but Mr Farey, in his late survey, doubts the accuracy of this opinion. From the rain-gauge kept in the gardens of Chatsworth, it appears, that the total depth of water fallen from the year 1763 to 1810 inclusive, including melted snow, was not more than 119 feet, giving an yearly average of 28,411 inches; and the average number of the days of rain in each month, was nearly as follows: January 9 days, February 10, March 8, April 9, May 9, June 9, July 11, August 10, September 11, October 12, November 11, December 11 days.

Soil and agriculture.

The soil of Derbyshire is almost as various as its appearance. In the northern parts of the county very extensive peat bogs exist; the soil in these parts consists chiefly of ligneous particles, being roots of decayed vegetables, mixed with the argillaceous vegetables earth or sand, and a coaly substance derived from decayed vegetable matter. The surface presents nothing but a barren bleak moss, thinly clothed with heath. But in many parts of the Peak there is to be found what the natives call a *corn loam;* this consists of virgin earth impregnated with nitre. Where this corn loam is in sufficient quantity, and meets with a stratum of marl or clay, it forms a desirable field for cultivation; but these spots are overbalanced by the vast tracts of barren hills and mountains, whose sides present very little soil, being chiefly composed of rocks. When the limestone forms the mountain, the soil, though scanty, is productive of the finer grasses, which form good pasturage for sheep.

The most common soil in the southern parts is a reddish clay or marl. This soil, which has little or no stone beneath the surface, is also found to prevail through the middle part of the extensive tract of limestone, which lies on the north-west side of the county; and consists of much calcareous earth, which readily effervesces with acids. Some parts of the southern districts are interspersed with small beds, and strata of sand, gravel, and other alluvial soils. The large tract of the county that produces coal, is covered with a clay of different colours. This kind of soil is also found in some parts, where the grit-stone is to be met with; but there it is of a black colour, and frequently of a bituminous quality. That on the north-east side of the county, where the limestone prevails, is of a brown colour and loose texture. The soil on the banks of the rivers and in the vallies is different from that of the adjacent parts, and evidently has been altered by the depositions from the frequent inundations.

Owing to the barrenness of the soil and the coldness of the climate, there is but little corn grown in the northern parts; and the attention of the farmers is chiefly turned to grazing and breeding cattle. But as we approach the southern extremity, tillage becomes more frequent; and on the eastern side of the country it chiefly prevails. The midland tracts have a mixture of pasture and arable land. About the town of Derby, all kinds of grain are cultivated; and the produce is, in general, very abundant. The course of tillage generally pursued is, fallow, wheat, barley, beans, or peas. Extensive crops of turnips and cabbage also are raised; and the cultivation of artificial grasses seems more and more attended to; indeed the whole agricultural system of the county is in a state of progressive improvement. But an uncommon species of culture, in which about 200 acres of this county are employed, is that of chamomile (*Anthemis nobilis.*) Slips from old roots are planted out about the end of March on a loamy soil, and the flowers are gathered in September. The yearly produce varies from 2 cwt. to 6 cwt. and the price per cwt. from 40s. to L.9.

Great attention has been paid, of late years, by the Derbyshire gentlemen, to improve the breed of their cows. The cows are, in general, horned, large, and handsome, yielding upon an average ten quarts of milk a day; and in good grass fatten very soon. They are most commonly speckled, with large and well turned horns, though of late the short horned Lancashire breed has been introduced and preferred by some. The primary object of the Derbyshire farmer is cheese-making, of which upwards of 2000 tons are annually sent to the London market. The Derbyshire cheese is of a good quality, generally mild, and in taste, though not in richness, resembling the Gloucestershire. Derbyshire is not famed for good butter.

Nature seems to have adapted the horses of this country to the different regions in which she designed them to labour. In the northern districts, the breed is small, light, agile, hard, able to undergo great fatigue, and capable of subsisting upon scanty fare; in the southern parts they are in general of a strong, heavy, and large size. The sheep also of Derbyshire are small in the north and large in the south.

Mineralogy.

Concerning the geology and mineralogy of the county, it may be expected that some remarks should be supplied. Our observations here, however, must be necessarily confined, as the principal facts and phenomena presented in the survey of the rocks and minerals of this district, will be selected in illustration of the articles devoted to the sciences to which they respectively belong. There are few, if any, parts of the kingdom, perhaps, more interesting in these accounts than the present. The influence of that powerful agent by which the surface of our globe has been so violently disturbed, is no where exhibited under circumstances more various, or instructive; neither, if we estimate its mineral products by the abundance of those which it furnishes to the necessities and comforts of civilized life, is there any portion of these islands with higher claims to our consideration; lead, iron, coal, and lime, have, from the plenty in which they have been yielded, long given it an important place in the history of the arts; and its supplies of zinc and copper, particularly of the former, are by no means inconsiderable. In the *variety* of its minerals, too, Derbyshire is not without some boast; and a few of the specimens of our cabinets, especially the elastic bitumen, or mineral pitch, which is found near Castleton, it contributes to the exclusion of every other part of the world. The whole of its rocks belong to those two classes to which geologists have attached the names of *alluvial* and *secondary.* It has been conjectured by Professor Jameson, and, indeed, by Brochant, that the limestones and amygdaloids, which form such conspicuous features in the county, are formations, which, in the Wernerian school, would be denominated *transitive;* but this, on examination, will probably not be found to be the case. The abundance of extraneous fossils which they contain, their connection with the coal series, and the absence of those external characters, which are usually said to attend this ambiguous and imperfectly defined class of rocks, all conspire to show, that by whomsoever this arrangement may be acknowledged, no part of Derbyshire can be properly considered as belonging to it. In speaking *generally* of the rock formations of the county, their dip may be said to be south-east. The highest strata of Derbyshire will from hence be expected on its southern boundary.

The uppermost regularly stratified mass in Derbyshire, and that consequently which occupies its southern boundary, is a reddish marl. This covers a large extent of surface, and possesses an additional claim to attention, from the gypsum, which, in particular places, is abundantly imbedded in it. At Chellaston, near Derby, this mineral has been got in great quantities from a very distant date; and in two other situations in the same neighbourhood, it has also been worked, but to a less considerable extent. In all these places, it occurs in a tract of land considerably, and abruptly, elevated above the surrounding country. This bed contains fossils or petrifactions, such as *gryphites*, *anomiæ*, *belemnites*, *mytili*, and *pentacrinites*. With these are mixed fragments, and detached masses of rock, brought from a distant part of the country, such as limestone, chalk, coal, fuller's earth, and a variety of others. In one instance, a block of limestone, evidently belonging to the uppermost of the four limestone strata of Derbyshire, the nearest occurrence of which is fifteen or sixteen miles from this point, was seen lying here, which was equal to at least five-and-twenty hundred weight (112 lbs. $\times$ 25.) Nearly the whole of the gypsum furnished from these situations is of the sort denominated by mineralogists *compact* gypsum. Specimens of the *foliated* and *fibrous* varieties occasionally occur, forming a thin bed of four or five inches thick, which lies a short distance above the former; but these, from a strange and unaccountable prejudice, are rejected by plasterers and others who use this mineral, under the impression that they are destitute of the properties possessed by the compact gypsum. The common name for this substance is plaster and alabaster, and its price is from 7s. to 9s. per ton, (120lbs. $\times$ 20) according to quality.

The next stratum which presents itself in Derbyshire, under the red marl, is the yellow, or magnesian limestone. This, however, instead of appearing in the southern districts, as might have been expected, does not occur till we reach Hardwich and Pleasley; but attends the eastern boundary of the county for about fifteen miles previously, just within the edge of Nottinghamshire.

Immediately under the yellow lime, lie the extensive and important range of rocks constituting the coal series of Derbyshire, Yorkshire, and, it may be perhaps added, of Lancashire. These principally consist of alternations of sandstone, clay, bituminous shale, slate-clay, and coal, in different states of induration. The number of sandstone rocks in Derbyshire is about twenty, and of coal beds about thirty, the latter of which vary in thickness from six inches to eleven feet. The total thickness of the coal measures in this county is, as nearly as can be estimated, about twenty-five yards. Their general dip is towards the south-east; but the dislocations and other accidents to which the coal field has been exposed, have produced many exceptions. Notwithstanding this, however, the order of succession in the different rocks may be so confidently relied upon, that the difficulty, in a practical point of view, becomes very much reduced; for wherever any particular stratum can be identified, those which accompany it may be immediately inferred. The value of this knowledge, both in the present, and in the neighbouring counties, has, in many instances, been most abundantly proved to its possessors, by the advantages they have been able to make of it in speculations respecting coal property. This was very strikingly shewn in Staffordshire, (the formations of which are widely different from those now under examination,) where an entirely new series of coals have, within these few years, been discovered, and brought into work, solely by the light which this species of information has supplied. The benefits have not been confined to the individual alone who first disclosed those hidden treasures, but has extended to the whole population of the neighbourhood, and to the kingdom generally.

The whole of the ironstone by which the iron works of Derbyshire are supplied, is furnished from the beds of slate and clay called *bind*, which alternate with the coal. It lies imbedded in these in the form of nodules, and for the most part, consists of the *reniform ironstone*, and *common clay iron-stone*, described by Professor Jameson. The latter occurs under various extraneous forms, such as of muscles, reeds, and ferns. The number of blast furnaces in Derbyshire now (1814), all of which, it is believed, are worked with coke, is about twenty. Several of these are out of blast from the depressed state of the iron trade, and will, in all probability, continue so, until our intercourse with America is revived, not from its direct, but from its indirect influence. The processes employed in the manufacture of iron in this district, do not appear to differ, in any essential point, from those practised with the same materials in other situations. The mechanical aid is in most, if not in every instance, furnished by steam, and the pressure with which the air is thrown into the furnace, on the average, perhaps may be considered as equal to about two pounds and a half on the square inch. To those interested in the manufacture of iron, it may be useful to add, that most of the furnaces in this county are worked with a bright tugen, arising from their being principally employed in producing soft metal. In returning from this digression, it remains only, before quitting the present subjects of inquiry, to say a few words concerning some other general appearances of the Derbyshire coal-field, it being impossible, within the space allotted for these remarks, to convey such a particular account of it as would be requisite for a complete geological acquaintance with its subordinate members. The total depth of the strata composing it, from the under surface of the magnesian limestone to the lowest sandstone, inclusive, is from seven hundred and fifty to eight hundred yards. The last rock alone, which is a coarse quartzose compound, measures a hundred and twenty yards, and is the one called, by Mr Whitehurst, (*Inquiry concerning the Earth*), and by Mr Farey, the *mill-stone grit*. It is much in use in the county for the making of mill-stones, (whence its name,) and also for the hearths of blast furnaces. Wherever it occurs, therefore, the coal may be considered as having all disappeared, and an intimate acquaintance, both with this, and with the yellow lime-stone, becomes, in consequence, a valuable sort of knowledge, since these two strata include the whole of the treasures of ironstone and coal furnished by the district. The first appearance of the limestone here mentioned, within the limits of the present inquiry, is between Wallaton and Bilborough in Nottinghamshire. Proceeding northward, its basset-edge afterwards occurs to the west of Stretley and of Nuttal, at Greasley, to the west of

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Annesley, at Kirkby, Hucknal, and to the west of Teversal; shortly after which it leaves Nottinghamshire, and appears in Derbyshire at Hardwich. From thence it passes by Alt Hucknal, Bolsover, to the west of Clown and Barlborough, and forward into Yorkshire. The line which it describes is very irregular, and there are some circumstances attending its geological history not yet satisfactorily explained. Our knowledge of the mill-stone grit is much more complete, the basset-edge of this stratum being the most distinctly and accurately defined of any in the county. Its first occurrence, to the southward, is at Little Eaton, about three miles to the north of Derby. It may from thence be traced to the west of Holbrook, at Belper, west of Heage; east of Crich, at Tansley; east of Darley in the Dale; east of Becley, on the ridge at the back of Chatsworth house; east of Curbar, at Fox house, and to the east of Hathersage; shortly beyond which point it crosses into Yorkshire. On the eastern side of all these places, therefore, bounded by the yellow lime as before particularized, lies the whole of the Derbyshire coal field; and to the west, the range of limestone and amygdaloid rocks, which remain yet to be described. The facility with which the geology of the county may be studied, by having these points fixed on the memory, must be immediately obvious; and the present sketch, in particular, will derive a very material assistance from it, in the sort of connecting link which it will supply to the scattered remarks here offered in explanation of the principal mineral features of this interesting neighbourhood.

In leaving the mill-stone grit, we next come to a considerable, but irregular formation, called, by Mr Farey, the lime-stone shale. Its thickness varies in different parts of the county from a hundred and forty to a hundred and seventy yards; and it is occasionally accompanied with beds of sandstone, sandstone slate, and black or dark blue limestone. Ironstone is also found in it, in some places, in considerable quantity; but the distance at which this is situated from coal, prevents it from being converted to any profitable use. It is in one of the beds attendant on this formation, that the tripoli, or *rotten-stone* of Derbyshire, is contained. This mineral occurs only with the black limestone, forming a coat on its upper surface of different thicknesses, and appears to be the result of a decomposition which the latter substance has undergone. However improbable such a change may be considered, specimens are in the possession of the writer of these remarks, obtained from the vicinity of Bakewell, in which the transition from one to the other is so distinctly shewn, that it seems impossible otherwise to account for the phenomena. Analysis, it is true, presents at first sight some formidable objections; but they constitute by much the lesser difficulty. Indeed, the change may be supposed to be wholly effected by the solution of the carbonate of lime in the water which filters through the rock, and which thus leaves the silex occupying its original situation.

Under the shale just described, lies the first great limestone rock of Derbyshire. This, in the neighbourhood of Crich, is quarried to an immense extent, for the various uses of agriculture and the arts. The lime yielded by it is of a most beautiful whiteness, and furnishes the bleachers of most of the neighbouring counties with the base of their bleaching liquor, for which it is peculiarly applicable, in consequence of the total absence of all metallic matter, and especially of iron. Beneath this, is a stratum of amygdaloid, or *toadstone*, as it is here termed, of which there are three distinct beds in the county alternating with limestone. They all cross the celebrated vale of Matlock, and either emerge, or basset, in the vale itself, or on the declivity of the ridge which bounds its western side. This was first described by the ingenious Mr Whitehurst, who has given a section, in the second plate to his work, shewing the position of the whole range, in the neighbourhood of Matlock, from the mill-stone grit downwards. The lowest stratum he has there marked, and indeed the lowest which is yet known in Derbyshire, is a fourth bed of limestone, lying under the third toadstone. The total thickness of these is about six hundred and fifty yards; the particulars of which are as follows:

Mill-stone grit	120 yards.
Great shale	150 . . .
First limestone	50 . . .
. . . Toadstone	20 . . .
Second limestone	50 . . .
. . . . Toadstone	30 . . .
Third limestone	70 . . .
. . . . Toadstone	30 . . .
Fourth limestone	130 . . .
	650

There is one error in Mr Whitehurst's delineation of the strata at this point, arising from his having supposed a dislocation or fault to exist in that part of the vale which formed the bed of the river Derwent. This Mr Farey has succeeded in proving to be a mistake, the angle which the different rocks make with the horizon being the same on each side of the valley.

The whole of the lead smelted in the county, is furnished by veins, which traverse the beds of limestone here mentioned. There is not an instance, it is believed, where the amygdaloid has ever yielded a single vein. Hard specimens have been found, in late years, containing small quantities of galena disseminated through them; but these are of very rare occurrence, and appear to be of a newer formation than the strata now under inquiry. One of the most curious and instructive phenomena connected with the history of the present series of rocks, is the occurrence of the veins, which are found at right angles to the dip of the limestone. These exist in each of the four beds, in the same relative situation; so that if the toadstone were removed, they would form one continued vein. The amygdaloid, however, has no corresponding appearance. Immediately at its surface the vein terminates; and miners are now aware that they must pierce the whole substance of the rock, and reach the subjacent limestone, before the object of their search will re-appear.

The lead ore yielded most abundantly in Derbyshire, is the galena, or lead glance. White and green lead ore are also got in considerable quantity, and are now worked in the smelting furnaces. This, however, has only been done within these few years. For many centuries they were thrown aside with the sulphate of barytes, (a *cawk*, as the miners term it,) under the belief that they were alike destitute of metallic matter; and many thousand tons are accumulated near the old workings, which, since the composition of these minerals was discovered, have all been re-explored, and continue, in many places, still to yield a profitable employment. A new species of lead ore was, some years ago, described by Mr Chenevix, as having been found

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at Matlock, consisting of muriate and carbonate of lead. No specimens have since been heard of, although inquiries and searches have repeatedly been made; nor is it known exactly from what part those Mr Chenevix examined were obtained. The most singular production of the lead genus presented in this county, is the *slickenside,* a specular lead glance of Professor Jameson. The phenomena exhibited on piercing the veins of this mineral have been fully described by Mr Whitehurst, and deserve to be noticed in the present account, since, however extraordinary and inexplicable they may seem, they may be confidently relied upon as authentic. The situation of the veins is perpendicular, and the greater part of the materials composing them is common calcareous spar. In the centre, parallel to the sides of the fissure, is a division, the two faces of which are polished, and coated with a very thin film of lead; and these constitute the substance under inquiry. The surfaces are not always plain, but often fluted like the ornamental wood-work of a joiner; and the quantity of lead distributed over them appears to be no greater than would have been left by small pieces of galena being exposed between them to violent friction. The most extraordinary circumstance connected with the slickenside is this, that if a sharp pointed instrument be drawn down the vein with a certain degree of force, the materials emit a crackling noise, and, in the course of a few minutes, explode with considerable violence, the fragments being thrown to a great distance. Several serious accidents at first happened in consequence, and the mines where the phenomenon occurred were for a considerable time deserted, till the workmen, becoming more intimately acquainted with it, found the means of guarding against future mischief, by scratching the substance with their picks, and afterwards retiring to a distant part of the work whilst it exploded.

It is to be regretted, that no particular information can be supplied concerning another product of Derbyshire, which, from its rarity, may be perhaps considered as the next in interest. The elastic bitumen is found in no part of the world but the neighbourhood of Castleton; and here the situation which affords it, is the property of two or three miners, who keep the place shut from every eye but their own, and do not resort to it except in the interval of several years, when they bring out considerable quantities, which are sold at a very high price. Their motive in dealing out the mineral so sparingly, is evidently to enhance its value, contriving just to keep pace with the public demand. It is supposed to be found in very large masses, from the appearance of the pieces these miners produce, which seem as if they had been dug with a spade. *Indurated* bitumen is mixed with the *elastic;* but this is not so rare a product.

Amongst the most abundant minerals of Derbyshire, not hitherto particularized, are carbonate of lime, which exists under almost every crystallized form presented by that substance; fluate of lime, or fluor spar, of which the beautiful ornaments, so well known over the kingdom, are made; sulphate of barytes, both amorphous and crystallised; sulphuret and carbonate of zinc, (blende and calamine,) and copper pyrites. The singular variety of carbonate of lime, called stalactite, is found here very abundantly. A cavern has lately been discovered at Bradwell, near Castleton, the roof of which is almost wholly covered with it. The appearance of this place is particularly beautiful, and is well worth the attention of travellers.

At Ashover, specimens of fluor have been found covered over with crystals of quartz, which is a fact highly deserving of being recorded, as marking the relative age of these substances. Lead glance has also, in the coal districts, been seen crystallised in nodules of iron stone, another circumstance not unworthy of being mentioned, from the information it supplies concerning the different eras at which that mineral has been deposited.

Subterraneous caverns.

Under the subterraneous geography of this interesting county, we may include the remarkable caverns and fissures, which abound in the northern parts of it. There are several small caverns in the neighbourhood of Matlock; but the only ones deserving particular notice, are those of Buxton, Castleton, and Elden Hole.

Poole's Hole.

That in the vicinity of Buxton is called *Poole's Hole,* and is a vast cavern, formed by nature, in the limestone rock. The tradition of the country says, that it was the residence of an outlaw of the name of Poole. The entrance is low and contracted, and the passage at first so narrow, that it is impossible to go forward without stooping; but after having proceeded in this posture for about five-and-twenty yards, the passage widens into a lofty and spacious cavern, the roof of which is beautifully adorned by the pendent stalactites. The droppings of the water, laden with calcareous matter, falling on the rugged floor, forms many masses of *stalagmite,* which the imaginations of those who shew the cavern have likened to many articles of common life. The visitor is conducted into the cavern along a path which winds along the side, at some height from its bottom; but the way by which he returns lies along the bottom. By thus changing the path, an opportunity is furnished of better ascertaining the height and width of the cavern in every part, and of viewing other accumulations of stalactite, some of which are of prodigious size and extraordinary form. The whole length of this subterraneous passage is about 769 yards; it belongs to the Duke of Devonshire, and is granted by him to nine old women, who act as guides, and receive the money given by the visitors. Above Poole's Hole, on the side of the hill, are the kilns and limestone quarries, which give employment to more than a hundred families. They live, like the Troglodites of old, in caverns of the earth; and though exposed to the variations of the seasons, and the ragings of the storm, they exhibit a longevity unknown to the population of the more civilized parts of the kingdom.

Peak cavern.

Peak Cavern, near Castleton, which is also sometimes called the *Devil's Cave,* is one of those magnificent, sublime, and extraordinary operations of nature, which at all times excite the admiration and wonder of the beholder. This cave has been regarded as one of the principal wonders of Derbyshire, and is celebrated by several poets. It is within 100 yards of the town, in a fissure or separation of the rock. It would be difficult to imagine a scene more august than that which the mouth of this cavern presents. On each side, the huge grey rocks rise almost perpendicularly to the height of nearly 300 feet, and meeting each other at right angles, form a deep and gloomy recess. In front, the mouth of the cave, overhung by a vast canopy of unpillared rock, assuming the appearance of a depressed arch, strikes the mind as solemnly grand. This natural arch is regular in structure, and extends in width 120 feet, in height 42, and receding depth 90. In this entrance or first cavern, a singular combination is produced; human habitations and twine manufacturing machines, blending with the sublime features of the natu-

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ral scenery. After penetrating about thirty yards into the cave, the roof becomes lower, and a gentle descent conducts, by a detached rock, to the interior entrance of this tremendous hollow. Here the light of day, which gradually softens, wholly disappears; and candles are put into the hands of the inspector, to illuminate his farther progress through the stygian darkness of the cavern. During his progress, the visitor is conducted through narrow passages, spacious, and almost roofless openings and hollows, and over a lake of water in a boat. The imagination of the man versed in classic lore, might fancy himself crossing the Styx in the fabled bark of Charon, so deep is the gloom, and so tremendous are the scenes around him.

The entire length of this wonderful cavern, from its entrance to its termination, is above 2250 feet; and its depth, from the surface of the mountain 621 feet. A stream of clear water runs through its whole length. From different parts of the cavern, communications open with other fissures; but none of them equal it, either in extent or grandeur. In extremely wet weather, the interior cannot be visited, as the water fills up a great portion of it, and rises to a considerable height even near the entrance; at other times, the access is not difficult, and quite safe.

Elden hole.

Elden Hole is situated at no great distance from Castleton, on the side of a gentle hill, to the north-west of the village of Peak Forest. It is a deep chasm in the ground, its mouth opening longitudinally in a direction from north to south. Its shape is nearly that of an irregular ellipsis, about thirty yards in length, and, in the widest part, nine broad. The northern end is fringed with small trees, and moss and underwood grow out of the crevices on each side, to the depth of forty or fifty feet. As the fissure recedes from the surface, it gradually contracts; and at the depth of 20 or 25 yards, inclines to the west, so that the eye can no longer trace its course. Many exaggerated accounts and marvellous reports have been propagated concerning this fissure. It has, at one time, been represented as perfectly unfathomable; at others, as teeming at a certain depth with impure air, so that no animal could respire it without immediate destruction. But these descriptions are erroneous, as many persons have, at different times, descended into it, and found that the first landing below the surface was not above seventy yards. The interior of the chasm at the bottom consists of two parts, one like an oven, the other like the dome of a glass-house, communicating with each other by a small arched passage. On the south side of the second cavern was a smaller opening about four yards long, and two high, lined throughout with a sparkling stalactite of a fine deep yellow colour. Facing the entrance, was a column above 90 feet high, of the same stalactite incrustation. On proceeding to the north, there is a large stone covered with the same substance, from which there is a rocky ascent of sixty feet; there is a descent on the other side into another cavern. The side of this, as well as another small cavern, were lined with incrustations of three kinds; the first was a deep yellow stalactite; the second was a thin coating, resembling a light stone-coloured varnish, and reflected the light of a candle with great splendour; and the third a rough efflorescence, the shoot of which was like a rose flower. These facts were communicated to the Royal Society, by Mr Lloyd, the only scientific person who ever descended into it, and are contained in the 61st volume of their Transactions.

Derbyshire.

Picturesque scenery.

Derbyshire has been long celebrated for the beauty of its scenery; and its dales constitute no small portion of its pleasing appearance. The first in the rank of beauty, as well as in size, is the far-famed and romantic *Dove Dale*, a name it has received from the river Dove pouring its waters through it. On entering this enchanting spot, it is impossible not to be struck with the almost instantaneous change of scenery, so different from the surrounding country. Here, instead of the brown heath, or the rich cultivated meadow, rocks abrupt and vast, their grey sides harmonised by mosses, lichens, and yew trees, their tops sprinkled with mountain-ash, rise on each side. The mountains that enclose this narrow dell, rise very precipitous, and bear on their sides fragments of rock, that, at a distance, look like the remains of some ruined castle. After proceeding a little way, a deep and narrow valley presents itself, into whose recesses the eye is prevented from penetrating, by the winding course it pursues, and the shutting in of its precipices, which fold into each other, and preclude all distant view. On proceeding, the scenery of Dove Dale gradually increases in majesty and rudeness. Now those objects, which at a distance seemed to have been ruins, are found to be rude pyramids of rock, and grand isolated masses, ornamented with ivy, rising in the middle of the vale. The rocks which enclose the dale, forcing their scattered and uncovered heads into the clouds, overhang the narrow path that winds through the dark recesses of the dale; and frowning with craggy grandeur, and shaggy with the dark foliage that grow out of the chinks and cling to the asperities of the rock, form a scene in romantic beauty unrivalled. On proceeding about a mile in the vale, fantastic forms and uncouth combinations, detached in vast mural masses, are met. Its sides are perforated by many natural small caverns, which are difficult of access. The length of Dove Dale is nearly three miles; but the views are more limited, from the sinuosity of its course, and its projecting precipices. Through the whole of this majestic feature of country, the river Dove rolls its transparent stream. On the right, or Derbyshire side of the Dale, the rocks are more bare of vegetation, than on the left, or Staffordshire side, where they are thickly covered with a fine hanging wood of various trees and odoriferous shrubs and plants. The character of the scenery is greatly diversified, by the varying form of the rocks, and the changing current of the Dove, the motion and appearance of which is perpetually altering. It is interspersed with small islands and little waterfalls. Dove Dale is no where more than a quarter of a mile wide, but in several places it almost closes, and hardly leaves a passage for its narrow river. The rugged, dissimilar, and frequently grotesque and fanciful appearance of the rocks, distinguish the scenery of Dove Dale from every other in the kingdom. On the whole, it is one of the most pleasing pieces of scenery of the kind that can any where be met with. It has something peculiarly characteristic. Its detached, perpendicular rocks, stamp it with an image entirely its own; and, for that reason, it affords the greater pleasure. This dale was a favourite resort of J. J. Rousseau, when he resided in its neighbourhood in the year 1767.

The other dales of Derbyshire, are Monsall, Middleton, Darley, Matlock, Lover's Leap near Buxton, Castleton, and that of the Via Gellia; all possessing great picturesque beauty, but bearing so strong a resemblance to Dove Dale, though on a smaller scale, that we shall not insert a separate account of each.

Derbyshire.

Buxton waters.

A description of its mineral waters deserves a distinguished place in an account of Derbyshire; as no county excels it in the number and variety of medical springs. The tepid waters of Buxton were held in great estimation as far back as the time of the Romans, who made a great use of them; as, about a century ago, the remains of a Roman bath were discovered near the source of one of the springs. From their time to the year 1571, when Dr Jones published a work on their virtues, which gave them great celebrity, they were never entirely forsaken. The first convenient house for the reception of visitants, was erected a short time previous to that publication by the Earl of Shrewsbury. This building occasioned the waters to be much more resorted to than heretofore, by all ranks of people. It was much frequented in the reign of Elizabeth, at which time Mary, Queen of Scots, paid it a visit, and since that period the yearly visitors have been regularly on the increase. The baths are five in number, inclosed in the building called the Crescent. The public baths are very large, but the private are small. The two springs which principally supply these, rise in a stratum of black limestone on the south-east side; but the water also bubbles up through the chinks between the stones with which the bath is paved. It is calculated, that all the springs throw out the water at the rate of sixty gallons in a minute. On a chemical analysis, Buxton waters have been found to be slightly impregnated with mineral matter, particularly calcareous earth, sea salt, selenite, and acidulous gas, with, perhaps, some other permanently elastic vapour. The almost invariable temperature of the water is 82° of Fahrenheit's thermometer; and is clear, sparkling, and grateful to the palate. The temperature of the baths is extremely agreeable to the feelings. The beneficial tendency of the water is particularly apparent in gout and rheumatism; in nephritic and bilious disorders, and debility of the stomach and intestines. The water, when drunk in any considerable quantity, occasions many feverish symptoms, such as a sort of giddiness, attended with a sense of universal fulness and drowsiness, and is found to possess a binding and heating quality; but in a few days these sensations go off, and it often happens that the patient does not feel the full benefit of the waters till he has left the place.

Matlock spring.

The Matlock warm springs are similar, in many circumstances, to those of Buxton. They issue from between fifteen and thirty yards above the level of the river; higher or lower the springs are cold, differing in nothing from common water. The quality of these waters has been examined by several medical gentlemen, who have borne testimony to their beneficial effects. The temperature is rather lower than that of the Buxton baths, being from 68° to 69°, and they exhibit more fixed air. They are agreeable to the palate, and impregnated with selenite, or earthy salts, and a small proportion of sea salt. Matlock contains three cold (or of the natural temperature), and two artificially warm baths.

Several theories have been advanced, in order to account for the natural heat of the Buxton and Matlock water; the most ingenious of which was proposed by Dr Darwin. He supposes that the origin of the heat of these waters is in the steam raised from deep subterranean fires. The strata in this part of Derbyshire, he says, consist of beds of limestone and lava (toadstone), which lie reciprocally on each other; and he sums up the whole argument, by stating the supposition, that "the steam rising from subterraneous fires, is owing partly to waters slowly subsiding upon those fires, and to limestone gradually calcined by them; from whence," he supposes, "it might happen, that this steam, rising through the perpendicular clefts in the super-incumbent rocks, must be replete with carbonic acid gas, and some phlogisticated air. If," continues he, "this steam, so impregnated, be condensed in limestone strata, the fixed air in this hot steam will supersaturate itself again with calcareous earth; which is what precisely happens at Matlock, where the waters are replete with calcareous particles, as appears by the copious deposition of tripha, or calcareous incrustation, along the channels in which they flow.

To this theory has been objected, that it is difficult to admit, that a subterranean fire could exist for so long a series of years as to keep up a regular and undiminished heat, capable of producing the effect above described; and that, whatever validity there may be in such an argument, it will be quite as difficult to imagine, that a bed of pyrites (the decomposition of which was said to have caused the heat) should be more inexhaustible than a body of unkindled fire." A new theory has lately been advanced: From the detection of saline matter in these waters, and the well-known property of sea salt to dissolve lime, it is conjectured, that the waters of these springs being previously impregnated with acid, become saturated with lime in its passage through the strata before described, and is afterwards decomposed by the addition of pyrites dissolved in the rain water, which percolates through the superincumbent strata; for pyrites containing sulphur, the heat that takes place during the solution of the pyrites, will necessarily disengage a certain proportion of acid; and sulphuric acid will immediately unite with lime when held in solution by the weaker acids, and, when united with it, fall down in a calcareous sulphate, and heat is again generated during the process.

Kedleston spring.

Another mineral spring, of a different description, is that of Kedleston, near Derby. It is situated near the seat of Lord Scarsdale, whose father, about fifty years ago, erected a building inclosing the spring in the centre, and surrounded by two warm and two cold baths. The Kedleston water is similar to the Harrowgate, but not so strongly impregnated. The spring is pretty copious; and the water, in a glass, looks very clear and transparent, but in the well it appears of a blackish blue colour, tinged with purple; and any substance thrown into it assumes the same appearance. Its smell is fetid; and though, on its first being put in a glass, it appears clear, yet, when it has stood for some time, a duskishness comes on, which is soon followed by a total loss of scent and taste. It is impregnated with sulphur, calcareous earth, and sea salt. It is principally valued and resorted to on account of its antiscorbutic qualities. By external application, it has been found efficacious in various cutaneous diseases, and more particularly in ulcerous complaints. It is frequented during the summer by a good deal of company. The temperature of the water is 53° of Fahrenheit.

At the distance of about half a mile from the above-mentioned place, is a large and strongly impregnated chalybeate spring, or rather a carbonated chalybeate, with the addition of a saline substance. It is chiefly drank for its tonic qualities: it has been found serviceable in chlorosis, flatulency, indigestion, and debility: it is much frequented. The temperature of the spring is nearly $49\frac{1}{2}$°.

Antiquities.

The antiquities of Derbyshire may be divided into

Derbyshire.

British antiquities.

British, Roman, and Saxon. Under the first head we may place the barrows, which are numerous in the northern part of the county; and a druidical temple, a circle of large stones, called Arboc-lous, situated on a barren eminence near the road from Wirksworth to Buxton. There is another smaller circle on Stanton Moor, together with others in different parts. There are also several large rocking-stones, and other remains of druidical superstitions, to be found in many of the northern districts.

Roman antiquities.

Among the Roman remains discovered in Derbyshire, the roads that cross it in two directions, and which may still be traced through a great part of their course, are the most prominent. The one, called the *Ilkenild-street*, comes out of Staffordshire, and runs in a north-eastern direction, on the western side of the county, as far as Chesterfield, and perhaps from there to York. The other road that has been investigated is called the *Bathway*, or *Bathing-gate*, and extends from Brough to Buxton, a distance of nearly twenty miles. The remains of Roman encampments are discoverable on Pentridge common, and on the top of Mam Tor, near Castleton. The ruins of the latter, still discernible, are considerable. It extended from north-east to south-west, along the ridge of an eminence, and occupied more than fourteen acres of ground. Chesterfield, we have no doubt, from its name, was a Roman station; but there are no remains of that people discoverable in the town, or its immediate vicinity. At Little Chester, near Derby, some walls remain.

Saxon antiquities.

Under the head of Saxon antiquities, we shall, for the sake of brevity, include the remains of ancient edifices, to whatever people they may owe their origin. At Castleton, there are considerable remains of the castle which gave it the name it bears. Its situation is very elevated, and the almost perpendicular chasms that nearly insulate the eminence it occupies, must, prior to the invention of gun-powder, have rendered it impregnable. This castle is of considerable antiquity, and is supposed to have been a fortress, (the town below is walled,) and a place of royal residence, in the Saxon times. Some antiquarians are of opinion that it is of Norman origin, and erected by William Peverel, natural son of the Conqueror. To him it is ascribed by the tradition of the neighbourhood; and its ancient appellation of *Peverel's Place in the Peke*, countenances this opinion. At the compilation of Domesday, the Peverels were its possessors; for about that time a tournament was held there, when Gevarine de Mez, a branch of the house of Lorraine, and an ancestor of the Lords Fitz Warren, vanquished a son of the king of Scotland, and a Baron of Burgoyne, and obtained the prize, which was a daughter of William, a sister's son to Pain Peverel, lord of Whittington, in the county of Salop, for his wife. Since that time, this castle and its demesne have passed through many possessors, and forms a part of the duchy of Lancaster. The present constable of the castle is the Duke of Devonshire.

There is also a considerable remain of *Codnor Castle*. In the early part of the thirteenth century, there are accounts of this castle; and in the reign of Henry III. it was the chief seat of the Barons Grey of Codnor. During the time of Henry VII. it passed from that family; and the estate is now in the possession of a private gentleman. Codnor Castle was situated on elevated ground, commanding an extensive prospect to the east. The wall on the eastern side is yet standing to a considerable height, and the wall on the west side of the court is entire. On the eastern side was a broad deep ditch, or moat; its remains indicate great strength. The park belonging to the castle comprehended more than 2000 acres of land.

At *Horsley*, in the neighbourhood of Derby, formerly stood a castle. It was built early in the thirteenth century, when one of the Ferrers, Earls of Derby, was governor of it. It was given by Henry VIII. to the Duke of Norfolk; but, upon the attainder of his son, it escheated to the crown, and was given to one of the Stanhope family. At present, a very small portion of its ruins is visible. The site of it belongs to the Earl of Chesterfield.

The vestiges of an ancient castle may be traced at *Melbourne*; but by whom, or at what period it was built, it is now impossible to ascertain. That it existed in the time of Edward III. is certain. Camden says, "not far from the Trent stands Melborn, a castle of the king's, now decaying, where John, Duke of Bourbon, taken prisoner in the battle of Agincourt, was kept nineteen years in custody." Leland says, that in his time "it was in tolerable and in metely good repaire."

In former times, *Duffield* was a place of great consequence, as it was the residence of the Ferrers, Earls of Derby. On elevated ground, at the north-west end of the village, stood their castle. At the conclusion of the thirteenth century, or the beginning of the following, this fortress was destroyed. For Robert de Ferrers, the last earl, joining the barons in a rebellion against Henry III. that monarch sent his son, Edward I. in 1264, into the county of Derby, in order to ravage, with fire and sword, the lands of the earl of that name. At that time, it is most likely this castle was destroyed; and so complete was the ruin, that not a vestige can now be traced of its ancient grandeur; not a stone remains to tell the inquisitive antiquarian where once it stood. But the site is known.

Ruins.

The most considerable ruin, in extent, to be found in the county of Derby, is that of the *manour-house of South Wingfield*. Its remains, which are extensive, exhibit many specimens of original magnificence. It was built, according to Camden, by Ralph, Lord Cromwell, in the reign of Henry VI. It consisted of two square courts; the northern of which was built on all sides, and the southern on three. Beneath the hall is an extensive vault, curiously and beautifully arched with carved stone, having a double row of pillars running up the middle, all in perfect preservation. This mansion was castellated and embattled; at each corner stands a tower; but that at the south-west rises higher than the rest. Mary Queen of Scots was confined for many years at South Wingfield. This edifice is supposed to have first suffered from an attack of the Royalists, in the time of Charles I. a party of whom, under the command of the Duke of Newcastle, in November 1643, took it by storm. But shortly after, Sir John Gill of Hopton assaulted it with cannon, and after making a considerable breach, obliged the garrison to surrender. In the year 1646, an order was issued for dismantling it. From that time it has been neglected, and falling into ruin.

At the time of the dissolution of the monasteries and abbeys, in the reign of Henry VIII. there were several richly endowed in Derbyshire. The Abbey of Dale, was a religious house of the Premonstratentian order, and inhabited by eighteen abbots. The whole revenue of this house was considerable, amounting to L. 144, 12s. besides some hundreds of acres of land, and many valuable and highly profitable grants. The arch of the east window of the church, is the only part that now

Derbyshire.

remains of this establishment. At Darley, in the immediate vicinity of Derby, was another abbey. The canons of the monastery of Austin friars of St Helen's, Derby, removed here in the early part of the reign of Henry II. The endowments of this house were great, besides its possession of many churches in different parts of the county, as well as extensive grants. At the dissolution, its annual revenue was valued at L.285, 9s. 6d. Soon after it was sold, and the principal buildings destroyed; but a few walls, some out-buildings, and a house called the chapel, now converted into dwelling-houses, may still be seen, and serve to point out the situation of the abbey. The priory of Breadsall, was the house of Friers Heremites, founded in the reign of Henry III. and was afterwards converted into a small priory for the order of St Austin. Its revenues did not amount to more than L.13, 0s. 8d. The Abbey of Beauchief, or *de Bello Capite*, was situated at a village of the same name, in a beautiful little vale, within a short distance of Sheffield. It was founded between the years 1172 and 1176, by Robert Fitz Ralph, Lord of Alfreton. It was dedicated to Thomas à Becket. Besides the endowments of its founder, many other grants and privileges were bestowed upon it. On the dissolution, its revenues were estimated at L.157, 10s. 2d. Of this extensive building, only a small part of the chapel now remains.

Prior to the year 660, there was a monastery of religious men and women at Repton, a village a few miles to the south-west of Derby; but the Danes, on their arrival in England, destroyed it. In 1172, it was rebuilt by Matilda, wife of Ralph, Earl of Chester, who founded a priory of canons of the order of St Austin. This religious house continued till the dissolution, when its revenue was found to be, according to Speed, L.167, 18s. 2d. Beneath the chancel of the church at this place, an ancient crypt was discovered some years ago. It is supported by two rows of round Saxon wreathed pillars, and supposed to be formed in Alfred's reign. A free school, with considerable endowments, was erected at Repton in the reign of Henry VIII. by the will of Sir John Port of Etwall, and continues to the present time in a very flourishing state.

Of the market towns of Derbyshire, the following are the principal: Chesterfield, Ashbourn, Belper, Alfreton, Wirksworth, Bakewell, Tideswell, Chapel-in-le Frith, and Wrinster; to which we may add Buxton and Matlock, of more recent origin: an account of the principal of which will be found under their proper names.

Principal county seats.

Derbyshire possesses several magnificent gentlemens' seats; but the following deserve particular notice: About two miles from Bakewell is *Haddon Hall*, a venerable mansion belonging to the Duke of Rutland. It is situated on a bold eminence on the banks of the river Wye, and consists of several apartments and offices, erected at different periods, round two quadrangular courts. The most ancient part was built in the reign of Edward III.; the other parts were erected from that time to the reign of Elizabeth, when the last addition was made. It was stripped of its ancient furniture about fifty years ago, and is now in a state of dilapidation. The extensive park is divided into portions; and its gardens, which consist of terraces ranged one above the other, entirely neglected. Haddon Hall is considered as one of the most complete baronial residences now remaining; and though not at present inhabited, nor in very good repair, is extremely interesting, from the many indications it exhibits of the festive manners and hospitality of our ancestors; and of the inconvenient, yet social arrangement, by which their mode of life was regulated.

Hardwicke-Hall, a celebrated seat belonging to the Duke of Devonshire, is situated on an elevated ridge of ground near the north-eastern boundary of the county. It stands in a fine and extensive park, well wooded; and between the trees, the towers of the edifice emerge with great majesty, their summits appearing covered with the lightly shivering fragments of battlements: these, however, are soon discovered to be carved open work, in which the letters E. S. frequently occur under a coronet; the initials, and memorials of the vanity, of Elizabeth, Countess of Shrewsbury, by whom this edifice was built. The house is of stone, having a lofty tower at each corner: in the front is a spacious quadrangular court, surrounded by a high stone wall. It affords a good specimen of English architecture in the 16th century. Mary Queen of Scots was confined here for many years, when under the care of the Earl of Shrewsbury; and a bed of tapestry work, on which she employed herself, yet remains in good preservation. But Hardwicke Hall is principally celebrated for its gallery of pictures: it is 195 feet long, and contains portraits of many illustrious characters by the first masters.

Chatsworth, another magnificent seat belonging to the Duke of Devonshire, was once reckoned one of the seven wonders of the Peak. It stands on a gentle acclivity, near the bottom of a high hill, finely covered with wood, in a narrow and deep valley, bounded by bleak and elevated tracts of land. The house, which is built in the Ionic order, with a flat roof, surrounded by a neat balustrade, may be considered as a noble specimen, of that highly decorated style of building, imported from Italy about 130 years ago: magnificent and heavy; expensive, but devoid of taste. Its form is nearly a square of about 190 feet. The interior as well as exterior of this edifice, is characterised by heaviness and gloom; and though splendidly ornamented with magnificent painted walls and ceilings, presents but few of those captivating productions of the pencil, which embellish the apartments of many other mansions in this county. It possesses, however, some attractions of another kind, which amply repay the visitant's attention: these are the beautiful carved ornaments by Gibbon. The water-works in the garden, are the principal objects of curiosity at Chatsworth. The famous cascade, one of those grand water-works, which half a century ago rendered it the greatest wonder of the neighbouring counties, has not yet lost its celebrity. It consists of a series or flight of steps, extending nearly 200 yards from one end to another, down a steep hill. This cascade is put in motion by turning a screw, at the temple near its summit, and the water rushes in vast quantities, and with great force and noise, from the dome of the temple, and from a great variety of dolphins, dragons, and a number of other figures that ornament it. There are also several canals, basins, and fountains; one *jet d'eau*, throws the water ninety feet high. All those works are supplied from a large reservoir of water on the top of the hill, covering fourteen acres of land, from whence the water is conveyed in pipes laid in the ground. Chatsworth has a very extensive park; and is often the residence of the present duke.

But *Kedleston-House*, the splendid mansion of Lord Scarsdale, is by far the most magnificent seat in the county. It is situated about three miles to the north-west of Derby, on a gentle ascent on an open piece of ground in the park. The front of this noble edifice measures 360 feet in length, and is a grand specimen

Derg || Descartes.

of Adams' architectural skill. The front is of white stone, and divided into three parts: a centre and two pavilions, connected to it by corridors of the Doric order, taking a sweeping form: that on the right, comprising the kitchen and offices; that on the left, consisting of Lord Scarsdale's private apartments. In the centre of the north front is a double flight of steps, leading to the grand portico, whose pediment is supported by six Corinthian pillars, proportioned from those of the Pantheon at Rome. The hall is planned after the Greek hall of the ancients. The coved ceiling is supported by twenty Corinthian columns of variegated marble, twenty-five feet high. The other apartments are the music-room, the drawing-room, the library, and the grand saloon, a most elegant room. In all these, there are innumerable paintings by the most eminent old masters, forming a private collection seldom surpassed in this country. Indeed, elegance and taste, characterise every thing within and about Kedleston. The park is very extensive, well stocked with deer, and adorned by a great number of venerable oaks. In front of the house, is a fine sheet of water, broken into several falls; and young plantations surround the whole visible horizon. Beside the seats above mentioned, there are Wingerworth Hall, the seat of Sir W. Hunloke; Willersley Castle, the seat of R. Arkwright, Esq. and many others of lesser note.

Manufactures.

The produce of the manufactories of Derbyshire, are various and extensive. The manufactories of cotton into thread, stockings, and calico, at Cromford, Belper, Derby, and other parts; of wool into hose, and cloth, on the borders of Nottinghamshire, and in the neighbourhood of Tideswell; of iron on the north-east side, and adjacent to Yorkshire; of silk, and also of ornaments made of spar, at Derby, are the principal, and employ some thousands of its population.

Such is a sketch of the history of the county of Derby, one of the most interesting in England. No one exhibits such a variety of scenery, or produces so rich a store of mines and minerals. It possesses some highly cultivated tracts, and a spirit of improvement has taken hold of its numerous and highly respectable country gentlemen. It numbers among its sons, many that have been, and are still eminent for science and knowledge; and its peasantry are highly moral, and in a considerable degree enlightened. (D.P.D.)

DERG LOUGH. See DONEGAL.

DERRIS, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 286.

DERRY. See LONDONDERRY.

DERVIS. See TURKEY.

DERWENT. See CUMBERLAND and DERBY.

DESCARTES, RENE DU PERRON, a celebrated metaphysician, mathematician, and natural philosopher, was descended of an ancient family, and was born at La Haye in Touraine, on the 31st of March 1596. He was the youngest of three children, and his mother died a few days after his birth of an illness which had been contracted during pregnancy. Although his father married a second wife, by whom he had two children, yet the cares of his new family did not interfere with the education of young Descartes, whom he was in the habit of calling "his philosopher," from the insatiable desire which he displayed to discover the causes of every thing around him. From the instability of his health, he was under the charge of females till near the winter of 1604, when he was sent to the Jesuits college of La Fleche, and put under the special charge of M. Charlet, a relation of his own, and rector of the college. After having spent five years in the study of the learned languages, in which he made uncommon proficiency, his attention was directed to logic and moral philosophy, from which he derived little satisfaction; but he was amply repaid for this unprofitable labour, from the delight with which he was inspired by his mathematical studies, into which he was initiated during his last year at La Fleche. Having received a dispensation from the strict scholastic discipline of the college, in consequence of the infirm state of his health, Descartes was enjoined by the rector to recruit himself by lying long in bed. He thus formed a habit, which continued during the rest of his life, of devoting these hours of quiet to those subjects of deep meditation, for which the greatest abstraction was necessary. When he had finished his course of study at La Fleche, which had lasted eight years and a half, he returned in the month of August 1612 to his father's house, accompanied with the blessings of his preceptors; but though he felt the warmest gratitude for the kindness and the instruction which he had received, yet he was dissatisfied with himself, and seemed to think that the utmost amount of his acquirements, was a full conviction of his own ignorance, and of the uncertainty of all human knowledge. He, therefore, resolved to abandon his studies; and, in consequence of this resolution, he went to Rheims to revisit his family, and he spent the whole of the year 1613 in riding, and fencing, and other exercises, which were considered as preparatory to a military life. Dreading, however, that his constitution was not sufficiently robust for the profession of arms, his father sent him to Paris in the spring of 1613, without any other guide than his valet de chambre, and left him the uncontrouled management of his time. A love of pleasure, and a strong propensity for gaming, in which he greatly excelled, were the natural consequences of his father's indiscretion; and had he not been introduced to Claude Mydorge, who succeeded Vieta in the reputation of being the first mathematician in France, and renewed his acquaintance with his fellow student Mersenne, he would probably have abandoned himself wholly to every species of intemperance. By their remonstrances, however, he was reclaimed from his vicious pursuits, and he gradually acquired that love of study, which had formed such a striking feature in his early character. His separation from Mersenne, who was sent about the end of the year 1613 to Nevers, to teach philosophy to the young religious of his order, produced a complete change in Descartes' views. He retired to the Fauxbourg of St Germains, with one or two domestics, and devoted himself wholly to the study of mathematics. His old companions sought for him in vain; and he had even the precaution to take his exercise in places where they were not likely to discover him. In this state of seclusion, Descartes spent two years. His precautions having been relaxed, his companions soon discovered the place of his retreat, and again allured him to the pleasures and amusements which he had forsaken. They had lost, however, their former relish, and he determined to try a military life. In May 1617, he set off for Holland, and entered as a volunteer in the Dutch army, under Prince Maurice. While he was quartered at Breda, some person had affixed on the corners of the streets a mathematical problem, and required the solution of it. Descartes observing a number of the passengers reading this placard, which was in Flemish, requested one of them to translate it into Latin. The person to whom this request was addressed instantly complied with it, but on the condition that he would transmit him the solution of the problem. Descartes accepted of the offer in a way so determined, as to excite the astonishment of the other party, who could scarcely believe that a young officer could solve a problem which appeared to him so difficult. Descartes found, from the card which he received, that he had been conversing with Isaac Beeckman, the Principal of the college of Dordrecht; and he was therefore doubly solicitous about the solution of the problem. On the following day he went to the house of Beeckman with the problem resolved, and offered also to show him the construction of it. Beeckman was surprised at this effort of his young friend, but was still more astonished when he found, by his conversation, that he was deeply versed in the knowledge of the times, and had gone far beyond himself in those sciences which had been the particular object of his own studies. After this singular rencontre, Beeckman and Descartes were friends and correspondents during the remainder of their lives.

When Count Maurice had become prince of Orange, in 1618, and carried his army against the Armenians, Descartes remained at Breda, where he composed his *Compendium Musicæ*, which was afterwards published at Utrecht in 1650, in 4to; at Amsterdam in 1656; and at London, in English, in 1653. Descartes spent a great part of his time in the society of Beeckman, who came to Breda in order to be near his learned friend; and it was at this time that he laid the foundation of several works, which he afterwards published.

The state of inactivity of the Dutch army, induced Descartes to quit Holland, and repair to Germany, where the coronation of a new emperor, the revolt of the Bohemian states, and the war between the Catholics and Protestants, had created a great ferment. He, accordingly, set out from Breda in July 1619, and, passing through Maestricht and Aix la Chapelle, he assisted at the coronation of Ferdinand II. at Frankfort. He now entered as a volunteer into the army of the Duke of Bavaria; and went into winter quarters at Neuburg on the Danube, in October 1619, where he devoted himself, without interruption, to his favourite studies. On the 18th of November 1619, as he himself informs us, when he was lying in bed, filled with enthusiasm, and occupied with the thought of having discovered the foundation of true science, he had three consecutive dreams, in which he thought that God had pointed out to him the line of life which he should follow, and the real method of investigating truth. Descartes believing that these dreams were of heavenly inspiration, prayed to God to assist him in his investigations; and in order to interest the Holy Virgin in the same cause, he vowed to perform a pilgrimage to our Lady of Loretto, which he accomplished after a lapse of some years.

Under the influence of similar feelings, he applied for aid to the Rosicrucians, who boasted of being divinely inspired; but he could find none of the sect who were able to unfold their system, and he was compelled to seek for truth in the only way in which it can be found, in the humble path of sober and patient inquiry. The Bavarian army having advanced to Suabia, Descartes went to Ulm in June 1620, and spent the greater part of the summer in that city. Here he became acquainted with John Faulhaber, a very learned man; and it is said that he at this time discovered the art of constructing, in a general manner, all sorts of solid problems, reduced to an equation of three or four dimensions. Descartes accompanied his regiment to Bohemia, and was present at the famous battle of Prague.

About the end of the year 1621, he quitted the Bavarian service, and entered the army of the Count de Bucquoy, which marched into Hungary in April. Descartes was present at the siege of Presbourg, Tirnaw, and several other places, where he is said to have signalized himself; but the raising of the siege of Neuhausel, where Bucquoy was killed, gave him a disgust with a military life. Having left the army, he visited Moravia, Silesia, Poland, Pomerania, and the shores of the Baltic; and, in order to see West Friesland with advantage, he purchased a boat, and embarked with a single valet. The sailors, thinking that he was a foreign merchant, and that much money would be found among his baggage, resolved to throw him into the sea, and seize his property. Imagining that he was ignorant of their language, and dreading no opposition from the tranquillity of his temper, they had the audacity one day to talk of the plan in his own presence. Descartes saw the danger to which he was exposed; and rising on a sudden, he drew his sword with the greatest fury in his countenance, spoke to them in their own language, and threatened to stab the first person that dared to insult him. Overawed at this unexpected display of courage, the sailors abandoned their cruel design, and carried Descartes in safety to the place of his destination. From West Friesland he went to Holland and the Netherlands, and he returned in safety to his father's house at Rennes, in the month of March 1622. His father took this opportunity of making over to him the inheritance which he derived from his mother, and which was situated in Poitou. After having resided for some time in Paris, and freed himself from the imputation of being a Rosicrucian, which had been fixed upon him by some of his enemies, he devoted himself to the study of mathematics and moral philosophy. In May 1623 he returned to Rennes, from which he repaired to his estate in Poitou, the greater part of which he sold with his father's consent. Descartes now resolved to perform a journey to Italy. After passing through Switzerland, the Grisons, and the Tyrol, he arrived at Venice, and afterwards performed the pilgrimage which he had promised to Loretto. In November 1624, he arrived in Rome, where he employed his time in studying the manners and dispositions of the people. In 1625, he left that city, and returned to Paris by the way of Tuscany and Savoy. The reputation of Descartes had, by this time, been widely extended; and his company was courted by all the learned men of Paris. In the years 1627 and 1628, his friend Mydorge directed his attention to the method of grinding lenses and mirrors; and Descartes arrived at a great degree of perfection, in executing even those of a hyperbolic and an elliptical form, which he found of great service in investigating the phenomena of vision, reflexion, and refraction. After having again resorted to a retired mode of life, and been again discovered by his friends, he went to see the siege of Rochelle, from which he returned to Paris; but the interruptions which he again met with, inspired him with a firmer resolution than he had yet taken, of retiring completely from society. He accordingly left Paris in 1628, committing the charge of his affairs to the Abbe Picot; and after having spent four of the winter months in the country, he went to Holland in March 1629. From Amsterdam he went to Egmond, a delightful village near Franeker in Friesland, where he fixed his residence.

In this sequestered spot, he turned his attention to metaphysics, theology, meteorology, and dioptrics; but as he had left in France almost all his tools for grinding lenses, he could not proceed so smoothly with his optical studies. An account of the parhelia which were seen at Rome on the 20th of March 1629, had been sent to him, both by Mersenne and by Renier or Reneri; and he was thus led to compose his valuable treatise on meteors, which also contains his discoveries respecting the rainbow.

After he returned to Amsterdam, he spent the whole of the winter of 1629 in chemical experiments, and in the dissection of animal bodies; and he informs us, that he every day found something new in these sciences. Having received a visit from his friend Mersenne, Descartes went to England in 1631; and in the neighbourhood of London, he made a number of observations on the variation of the needle. Henry Reneri, who was the first person that embraced the opinions of Descartes, was elected Professor of Philosophy at Deventer, a circumstance which induced the latter to take up his residence in that town in the spring of 1633. Here he completed several works which he had formerly begun, but particularly his Dioptrics, and his "Treatise on the World;" and he applied himself principally to the study of astronomy. His "Treatise on the World" having been carefully revised, he was on the eve of sending it to Mersenne to have it printed at Paris with the royal privilege; but having heard of the persecution of Galileo, he was obliged to abandon this design, as his own work contained similar opinions.

From Deventer, Descartes went to Amsterdam in 1634, and he soon after performed a tour through Denmark and the lower parts of Germany with his friend M. De Ville-Brissieux, a celebrated mechanic and chemist of those times. From Amsterdam, to which he returned, he again went to Deventer, whence he set off to Leuwarden in Friesland, where he composed his treatise on mechanics. In March 1636 he returned to Amsterdam; and, in passing over the Zuyder Sea, he made some curious observations on the coloured rings with which candles are sometimes surrounded.

On the 4th May 1637, he obtained, in the most honourable manner, the royal privilege, not only to publish those treatises which he had prepared, but also every thing that he had written, or might still write, during the rest of his life. These treatises were published anonymously at Leyden, in 4to, and entitled, *Discours de la Methode pour bien conduire sa raison, et chercher la verité dans les sciences. Plus, la Dioptrique, les Meteores, et la Geometrie qui sont des Essais de cette methode.* In presenting copies of this work to his friends at Paris and Rome, Descartes omitted to send one to Roberval, professor of mathematics at Paris; and it is said, that this neglect was the cause of that bitter animosity which he ever afterwards felt and displayed towards Descartes.

Among the numerous combatants that were called into the field by the publication of Descartes book, the most distinguished was M. Fermat, counsellor to the parliament of Thoulouse, and one of the finest mathematicians of the age. Fermat stated several objections to the dioptrics of Descartes, and, before he received his reply, he sent him a copy of his book *De maximis et minimis*, under the name of M. Carcavi, a friend of his own. This present gave rise to a new dispute, which was carried on at Paris through the medium of Mersenne and Mydorge on the part of Descartes, and M. Pascal and Roberval on the part of Fermat. The dispute became at last personal, owing to the intemperate hostility of Roberval; but Fermat had the good sense to disapprove of this conduct, and it had the effect of producing a complete reconciliation between the two contending mathematicians. Descartes took a keen part against Roberval, in the question which was now agitated in France respecting the cycloid; and his time was almost wholly occupied in unprofitable replies to the objections which were every where urged against his philosophy.

The Cartesian doctrines were now making rapid progress in Holland, in consequence of the zeal of Reneri, who had been removed from the university of Deventer to that of Utrecht. One of his disciples, named Henry Regius, imbibed the same views with his master, and was so eager to make himself acquainted with the new philosophy, that he went to receive instructions from Descartes himself. The death of Reneri, which happened about this time, removed the restraint which his high reputation had laid upon the enemies of Descartes at Utrecht, and called forth the hostility of Voetius, who was professor of divinity in that university. This theologian, who was also the principal clergyman in the city, published theses in June 1639, in which he branded the new philosophy as atheistical, and as pernicious to the Protestant religion, and the repose of the United Provinces. These insinuations were ably repelled by his colleague Regius. The professor of divinity, irritated at the ability of this reply, determined to ruin the reputation of Regius as well as that of Descartes. In Regius's Lectures on Medicine, he sought for the opportunity which he wished; and he soon found, that this enlightened physician had taught the heretical doctrine of the circulation of the blood, which had been discovered by our countryman Harvey. A complaint was, on this ground, laid before the university, and Voetius had the address to interest even the rector and the personal friends of Regius and Descartes, against the new opinions; and to induce the university to publish an ordonnance, to prevent the dissemination of opinions contrary to its statutes. The troubles which were excited by this dispute, attracted the notice of the civil power; and it was at last agreed, at the suggestion of Descartes, in his answer to the ordonnance, and with the approbation of the magistrates of Utrecht, that Regius should be allowed to teach the new philosophy, but that he should be admonished to moderate his zeal, and to modify some of the boldest of his opinions.

The opinions of Descartes were received in England with great avidity. Lord Charles Cavendish, the brother of the Duke of Newcastle, who was enamoured of the Cartesian philosophy, invited Descartes, and his friend Mydorge, to settle in England. Descartes seemed disposed to accept of the invitation, particularly when he was assured that the king was a Catholic in his heart; but Mydorge, who had a family at Paris, did not comply with the same readiness. Charles I. promised to make a handsome provision for the two mathematicians; but the commencement of the civil war induced all parties to abandon the arrangement.

The tranquillity of Descartes was about this time disturbed by a dispute with the Jesuits, in which he was embroiled by M. de Saumaise. M. Bourdin, professor of mathematics in the Jesuits college of Clermont, attacked the tenets of Descartes, but particularly his dioptrics, in theses, which were supported on the 30th of June 1640, and his friend Mersenne defended him.

as usual; but believing that the whole company of Jesuits were combined against him, and that Bourdin wished to throw ridicule upon his opinions, Descartes lost the usual serenity of his temper, and declared war against the whole society. He addressed a letter, full of vigour and respect, to the rector of the college, complaining of the conduct of Bourdin; but the rector left it to his colleague to defend himself, and the dispute was long carried on between the Jesuits and the Cartesians without any profitable effect. During this dispute, Descartes lost his father, and his daughter Francina, to whose mother there was no proof of his having been married, and a long time elapsed before he recovered from this severe affliction. In 1640, Louis XIII. at the advice of Cardinal Richelieu, invited Descartes to Paris, upon the most honourable terms; but the high inducements which were held out, could not prevail upon him to leave his retirement. In 1641, Descartes published his *Meditations touchant la première philosophie, ou l'on demontre l'existence de Dieu, et l'immortalité de l'ame,* which involved him in fresh contentions. His enemy Voetius, who was now promoted to the rectorate of the university of Utrecht, renewed his attacks against Regius and Descartes, and succeeded, after many intrigues, in procuring a decree of the magistrates, and a resolution of the university, to prevent the former from teaching any thing else but medicine. But while Cartesianism was thus persecuted in Holland, it was making rapid advances in France among the Jesuits, some of whom even composed abridgments of Descartes' " Meditations." The reputation of Descartes was now so widely extended, that crowds of visitors flocked to see him in his retirement at Eyndegeest near Leyden; but the pleasure which he derived from these attentions was again embittered by the new hostilities of Voetius, who published in 1640, under the name of his friend Schookius, a work entitled, *Philosophia Cartesiana sive admiranda methodus novæ philosophiæ Renati Descartes.* This work was answered by Descartes in his *Epistola Ren. Descartes ad celeberrimum virum D. Gisbertum Voetium, in qua examinantur duo libri nuper pro Voetio Ultrajecti simul editi, unus de confraternitate Mariana, alter de Philosophia Cartesiana.* This reply irritated Voetius to such a degree, that he publicly charged Descartes before the magistrates as guilty of gross defamation; and having suborned five witnesses, Descartes was summoned to appear as a criminal at Utrecht. The French ambassador, however, remonstrated against this conduct to the Prince of Orange, who immediately put a stop to the views of Voetius, whose calumnies and bad conduct were afterwards exposed before a court of justice at Groningen. After having settled a violent dispute with Gassendi, and made a tour through France, for the purpose of visiting his friends, Descartes returned to Paris, where he found complete copies of his *Principia Philosophiæ,* which was published in 1644 by Elziver, and of a French translation of his *Essais,* which had been completed under his own eye by M. de Courcelles. His *Principia* was dedicated to Elizabeth, Princess Palatine, and daughter of the unfortunate Prince Frederic V. This lady was a zealous disciple of Descartes; and not satisfied with reading his works, she went to Eyndegeest to receive instructions from Descartes himself, and made the most wonderful proficiency in her metaphysical studies.

Descartes again sought for tranquillity at Egmond in Holland, that he might apply himself to the study of animals, plants, and minerals; but the ingratitude of his friend Regius, who began to appropriate to himself the discoveries of his master, and who inserted in his *Fondemens de Physique,* a great part of Descartes' Treatise on Animals, which he had seen in MS. was the source of great uneasiness. His anatomical pursuits were in some measure interrupted, by the problem of the quadrature of the circle, which was now agitated among mathematicians, but which he declared to be an useless and an impracticable attempt. In the winter of 1645, Descartes wrote a small tract in reply to Gassendi's *Instances,* and also composed a work on the " Nature of the Passions." In 1646, he conducted a dispute with Roberval, respecting a question of Pappus, and the oscillation of bodies suspended at one of their extremities, and carried on a correspondence with the Princess Elizabeth on moral philosophy.

M. Chanut, the French resident at Stockholm, who had long been the intimate friend of Descartes, applied to him in 1647, as arbiter between himself and Christina Queen of Sweden, on a point in moral philosophy, about which they had differed. In consequence of this application, he wrote a treatise on " Love," with which the Swedish queen was highly delighted. Having returned to France in 1647, the king granted him a pension of 3000 livres, in consideration of his great talents, and of the advantage of his researehes to the human race, and also for the purpose of enabling him to carry on his experiments. After he had again taken up his abode at Egmond, he was ordered by the French court to return to France, with the promise of a new pension, and of an honourable situation, which would not interfere with his researches. The state of public affairs, however, was changed before he reached Paris, and he found that all the promises which had been held out to him could not be fulfilled. He accordingly returned to Holland, where he received an invitation from the queen of Sweden to visit Stockholm, and initiate her into the principles of his philosophy. In October 1649, he arrived in Stockholm, and was received by the queen with that respect and affection which were due from a sovereign who could appreciate his talents. She rose every morning at five o'clock, to receive instructions from Descartes; and she persuaded him to revise and digest the unpublished MSS. which he had brought with him from Holland. In spite of the mean jealousies of some of the Swedish nobility, who envied the attention which he received from Christina, that enlightened sovereign strained every nerve to establish Descartes in her kingdom; and she had repeated conferences with the French ambassador respecting the best method of executing her plans. The delicacy of his health was the principal difficulty which was to be encountered. She proposed to give him an annual revenue of 3000 crowns, and the possession in perpetuity of the property from which it was derived; and lest the climate should be too cold, she agreed that he might reside either in the archbishopric of Bremen, or in Swedish Pomerania. The illness of the French ambassador, however, prevented any arrangement from being completed; and no sooner had he recovered, than Descartes caught a severe cold, which terminated in an inflammation of his lungs, which carried him off on the 11th of February 1650, in the 54th year of his age. Christina was inconsolable for the loss of her illustrious master; she sent for the French ambassador, and expressed her wish to bury Descartes at the public expence, to lay his ashes beside those of the Swedish kings, and to erect a magnificent mausoleum to his memory. The ambassador, however, proposed, that the funeral should be simple, and conducted at his own expence; and his remains were accordingly interred in the cemetery for foreigners, which had been appropriated for Catholics, and children who died before they had the use of their reason. A monument was erected over his ashes, and in a few months afterwards a medal was struck in Holland in commemoration of his brilliant talents.

About 17 years afterwards, M. D'Alibert, treasurer-general of France, conveyed the body of Descartes, at his own expence, to Paris, where it was interred, with great pomp, in the church of St Genevieux du Mont, and a bust in bas relief, with an appropriate inscription, was raised over his grave.

In the personal character of Descartes, we have not to lament any of those vices with which genius is so often allied. If the most unsullied integrity, if piety which was never excited by self-interest, if a constant disposition to forgive his enemies, and live with them in peace, if a contempt of wealth and honours;—if these leading features, united with all the lesser virtues, conspire to form a great character, Descartes, who possessed them all, must stand high in the estimation of posterity. Even the unsettled habits of his life, and the sudden changes from the most sequestered privacy to the bustle and gaiety of a court, never disturbed the tranquillity of his mind, nor engendered any of those habits by which the most virtuous are sometimes ensnared.

His physical and metaphysical writings cannot be viewed in any other light than as ingenious speculations, and the productions of a vigorous fancy; but his optical and his mathematical discoveries, if he had done nothing else, would have entitled him to that immortality which he is now enjoying. In various articles of our work, we shall have occasion to give an account of the leading tenets of the Cartesian philosophy; we cannot, therefore, detain our readers at present with the detail of opinions which must necessarily appear under these articles.

Besides the works of Descartes which we have mentioned, he left the following in MSS.: 1. A Treatise on Man; 2. On the Formation of the Fœtus; 3. On Light; 4. An Explanation of Engines; 5. Letters. All of these, except the Explanation of Engines, were published by M. Clerselier. The two first appeared with the notes of Louis de la Forge; and his Letters were published in three volumes.

Descartes left also several fragments: such as his Treatise on Algebra; Papers on Metals, Plants, and Animals; An Abridgment of Pure Mathematics; Detached Thoughts on the Soul, on Nature, and on the Construction of the Universe. He had also begun a work, entitled, *Studium bonæ mentis;* and another, written in the form of a dialogue, entitled *Recherche de la verite par la lumiere naturelle, qui toute pure et sans emprunter le secours de la Religion ni de la philosophie determine les opinions que doit avoir un honnete homme sur toutes les choses qui peuvent occuper sa pensee.*

See Baillet *La vie de M. Descartes contenant l'histoire de sa Philosophie et des ses autres ouvrages,* Paris, 1693; Perrault's *Hommes illustres du* xvii. *Siecle;* M. Thomas' *Eloge de R. Descartes,* which was crowned by the French Academy in 1765; Brucker's *History of Philosophy,* by Enfield, vol. ii. cap. 2; and Montuclas *Histoire des Mathematiques,* tom. ii. See also ALGEBRA, vol. i. p. 416, METAPHYSICS, OPTICS, and PHYSICS. (π)

DESFONTAINIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 171.

DESIGN. See PAINTING.

DESIGN, in Weaving. See CLOTH MANUFACTURE.

DESMANTHUS, a genus of plants of the class Polygamia, and order Monœcia. See BOTANY, p. 344.

DESPOTISM. See GOVERNMENT.

DESSAU, in Latin *Dessavia,* is a town of Germany, in the principality of Anhalt Dessau. It is situated in a delightful plain on the Mulda, at a short distance from its confluence with the Elbe. The streets in the new part of the town are wide and handsome, and the public buildings are elegant. The principal of these are, the palace, the new chancery, the riding school, the hunting house, the bridge over the Elbe, and the cemetery, which is remarkable for its monuments. Besides these, there are two Calvinistic and one Lutheran church, a grammar school, and several charitable foundations. The gymnasium, formerly the philantropinum, which was founded hy Basedow, for the education of boys of good family, has given great celebrity to Dessau. There is also in this town a chalcographick society, and an institution for the education of the Jews. The institution established at Dessau for printing and publishing books on account of the authors themselves, without the interference of booksellers, contributed greatly to the diffusion of knowledge. The most interesting objects in the neighbourhood of Dessau, are the embankment against the Elbe, which is about 60 feet broad at its base, about 10 or 11 feet high, and about 25,016 feet long; and the castle and park of Woerlitz. The principal manufactures are woollen cloths, tobacco, stockings, and hats. Population 7000. See *Wegweiser durch die Scheuswurdigkeiten in Dessau von* Rode Dessau, 1795. (*j*)

DETARIUM, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 221.

DETROIT, a port town of the United States, and principal place of the county of Wayne. It is situated between the lakes Erie and St Clair, on the western bank of the Detroit river. The town consists of several narrow and dirty streets, which run parallel to the river, and are crossed by others at right angles. The foot-paths are formed of square logs, in order to accommodate the passengers in wet weather. The town is encircled with a strong stockade, with four gates, which are defended by block houses. On the west side of the town is a small square fort, with bastions, and a field piece at each corner. The town contains a Roman Catholic church, and a Huron church on the other side of the river, which was formerly devoted to the Huron Indians. There are extensive wooden wharfs for the accommodation of the shipping; and there are no fewer than twelve trading vessels belonging to the town, so that it carries on a very considerable commerce, which consists in exchanging coarse European goods for the furs, deerskins, and tallow of the natives. Number of houses 300. Population 1200. West Long. 82° 56′, North Lat. 42° 40′. (*j*)

DETTINGEN. See BRITAIN, p. 627.

DEUCALION. See DELUGE and MYTHOLOGY.

DEVAUXIA, a genus of plants of the class Monandria, and order Polygynia. See Brown's *Prodromus Plant. Nov. Holl.* &c. p. 252, and BOTANY, p. 84.

DEVIL. See DEMONIACS.

DEVIZES, a market and borough town of England, in Wiltshire. The town has an elevated situation, Devonshire.

and the buildings are old, and chiefly built of timber and plaster, though several of the houses and shops are handsome. The principal public edifices are two churches, a chapel, and four meeting-houses for dissenters. The ditch, with which the river was inclosed, forms a road round the town, and upon a small eminence within the town, the ruins of its strong castle are still to be seen. The principal manufactures of this place, which are kerseymeres, broad cloth, and serges, employ about 1800 individuals; and a great trade in malt and corn is carried on, by means of the Kennet and Avon canal, which is close to the town.

The following is an abstract of the population return for 1811.

Number of houses	696
Number of families	855
Families employed in agriculture	191
Families employed in trade and manufacture	498
Males	1776
Females	1975
Total population in 1811	3750

(*j*)

DEVONSHIRE, a maritime county in the south-west of England, is bounded on the north and north-west by the Bristol Channel, on the south and south-east by the English Channel, on the west by the county of Cornwall, and on the east by the counties of Somerset and Dorset. It is divided from Cornwall by the river Tamar, and a small rivulet called Marsland-water: The boundaries between it and the counties of Dorset and Somerset are artificial. Its figure is nearly rhomboidal: From north to south it is nearly 70 miles, from east to west about 65, and in circumference about 280 miles. It is reckoned that there are 52 miles on the Bristol Channel, and 82 on the English Channel, in a direct line, not including the prominent headlands and coves or inlets. The shores of Devonshire, on the English channel, are flat, gravelly, or sandy; and this coast, in general, consists of a great number of bays, not deeply incurvated, which are bounded by headlands, composed for the most part of reddish clay or sandstone. The coast on the Bristol Channel is more bold and picturesque. In point of size, Devonshire is the second county in England, being inferior only to Yorkshire. It is reckoned to contain about 1,600,000 acres. It is divided into 33 hundreds, and subdivided into 432 parishes and tythings, besides the 22 parishes which are contained within the boundaries of Exeter. There are in it 40 market towns. It sends 26 members to parliament, two for the county, and two for each of the following places: Plymouth, Exeter, Tavistock, Dartmouth, Ashburton, Barnstaple, Tiverton, Oakhampton, Honiton, Plympton, Totness, and Beeralston. The principal places in it besides these, are Crediton, Biddeford, Axminster, Chudleigh, Cullumpton, Combe Martin, Ilfracombe, and South Molton. Devonshire lies within the province of Canterbury, and diocese of Exeter. It is included within the western circuit, pays one-twentieth part of the land tax, and provides 1600 men for the militia.

Boundaries and extent.

Natural divisions.

Devonshire is naturally divided into the districts of Dartmoor, the Vale of Exeter, South Hams, West Devonshire, and North Devon. Dartmoor stretches across the county, from Exeter to the borders of Cornwall. It is a rushy, naked morass, bounded on the north by bleak hills. In this district, taken in its most comprehensive sense, there are nearly 250,000 acres of open and uncultivated lands; and, what is strictly called Dartmoor, is supposed to comprise upwards of 80,000 of these. The forest of Dartmoor belongs to the Prince of Wales, in his character of Duke of Cornwall; but the outskirts belong to the surrounding manors, many of which have a right of common on the forest, on paying a small sum of money, called *Venville* money. It was originally made a forest by King John, and its boundaries accurately ascertained in the reign of Henry III. Immense masses of granite lie on its surface, which are distinguished by the name of *Tors*. To the north and west of the moor, there are vast tracts of wet swampy ground, which supply the neighbouring inhabitants with peat for fuel. Besides the common peat, a singular species is found, which, when dried and charred, is used by the smiths for tempering their tools. In those parts of Dartmoor where peat is not found, the soil consists of a thin, black, and light mould, lying on a pale, cold, yellow clay, intermixed with sand and gravel. On the higher parts of this district, the soil is of a superior quality, consisting of a good loam. Though Dartmoor forest was undoubtedly covered with wood formerly, at present only a few oaks, of unhealthy appearance and stinted growth, with a few trees of mountain ash, willows, &c. are to be found. The mean height of the forest of Dartmoor, deduced from the trigonometrical survey, conducted by Colonel Mudge, is 1782 feet; and the mean height of the most commanding situations of the county below Dartmoor, by the same survey, was found to be 737 feet above the level of the sea. The Vale of Exeter is a district of a quite opposite character to that which has been just described. It is bounded on the north by the hills that stretch from Clanaborough to Black Down; on the south-east, by the Sidmouth hill, East Down, and Woodbury; on the west, by the mountainous tract of Haldon, and the less elevated hills that lie towards Bow; and by the east by a mountainous ridge, a continuation of the hills that bound it on the north. This district contains about 200 square miles. In the central and southern parts the surface is nearly level, but between Tiverton and Exeter, and Exeter and Cullumpton, there is a good deal of rising ground. The soil of this district varies considerably; but it consists principally of a strong red loam, of uncommon fertility, and of what is provincially denominated *shillet*, a foliated clay, inferior in fertility to the red soil, and extremely liable to be parched in a dry summer. The district of South Hams is the most fertile in Devonshire. It is bounded on the north by Dartmoor, and the high grounds near Chudleigh; on the south by the English Channel; on the west by Plymouth Sound; and on the east by Torbay. It comprises nearly 250 square miles. The northern part of this district is distinguished for its romantic and picturesque scenery. The soil, in general, is a strong red loam, similar to that which is found in the vale of Exeter; the subsoil, a strong clay. The district of West Devonshire is bounded on the east by the Dartmoor mountains; on the west by the river Tamar; on the north by Brent Tor, and the contiguous heaths; and on the south by Plymouth Sound. The appearance of this district is very striking; the vallies in it generally rise with a steep ascent from the banks of the rivulets that divide them, while the hills are rent and broken in a very singular manner. The soil is pretty uniform, consisting of what is called *tilt*, on a substratum of soft, slaty rock or rubble. The district of North Devon is sometimes understood to comprise the whole tract of country lying between Dartmoor and the British Channel,

Dartmoor.

Vale of Exeter.

South Hams.

West Devonshire.

North Devon.

but more commonly it is confined to the country which lies round Biddeford, Barnstaple, South Molton, and the Northern coast. The soil of this district is very fertile, except on the summit of the hills, where it is thin. The surface is greatly diversified, and the scenery uncommonly beautiful.

Climate.

The climate of Devonshire is remarkable for its mildness; the myrtle grows and flourishes even on the shores of the southern coast. On the northern coasts, the weather is sometimes bleak and tempestuous, though even here, about Biddeford and south Molton, the Dutch broad-leaved, double-flowering myrtle, as well as the more delicate, aromatic, and narrow leaved sorts, flourish in the open air, and frequently form part of the garden hedges. In North Devon snow seldom lies for any length of time, except on the summits of the highest hills. About Ilfracombe, vegetation is found to be a fortnight earlier than on the cultivated lands at the foot of Exmoor. From this forest, the north-west winds blow with great keenness in the spring of the year, and the westerly winds from Dartmoor are likewise considered very injurious to the vegetation of that part of the county which is exposed to them. The districts of the vale of Exeter and of South Hams are the mildest and the most salubrious in Devonshire, and are supposed to be more so than any other part of England. The air, too, is much drier than in the other parts of the county, which, on account of its position between two seas, is, in general, too much inclined to moisture.

State of property.

The landed property in this county is very much divided; a large proportion of it being in the possession of respectable yeomanry. The sees of Exeter, York, and Salisbury, the dean and chapter of Windsor, the Universities, and the duchy of Cornwall, likewise possess considerable estates. Land is mostly held by life tenures, the estates being leased out for three lives, nominated by the purchaser. In some parts, however, particularly in the district of South Hams, this kind of tenure is falling into disuse, and leases for 14 years are becoming prevalent. The size of farms varies considerably; but there are very few that exceed 300 acres. The larger farms are provincially termed *Bartons*.

Agriculture.

In the vale of Exeter, wheat, barley, beans, and pease, are principally cultivated on the arable lands; the pasture lands are appropriated to the dairy, except in a few places, where the breeding of sheep and cattle is attended to. In the district of South Hams, the productions of the arable land are the same as those in the vale of Exeter, with the addition of turnips and potatoes. The upper grounds of this district are principally arable; there is, however, some pasture. The lower grounds are almost entirely cultivated as meadows. In the district of West Devonshire, the greater part of the inclosed lands are employed in the convertible husbandry. The system of artificially watering land has been practised here for a great length of time, but on a defective and objectionable plan. *Devonshiring*, or *Denshiring*, as it is more generally called, *i. e.* paring and burning, seems to have originated in this district. In the district of North Devon, wheat and oats are mostly cultivated. Great quantities of cyder are made in the district of South Hams, as well as in that of the Vale of Exeter: the red streak apple is generally preferred for this purpose. Sweet cyder is principally made in the neighbourhood of Haverton; the sweet taste is given to it by its being often racked, which checks the fermentation. The moisture of the climate of Devonshire is supposed to render its cyder more harsh and sour than that of Herefordshire. There is little peculiar in the Devonshire method of gathering fruit for making cyder, except in the circumstance of its being gathered either wet or dry. The Herefordshire press is generally preferred. The fermentation is permitted to go on till the liquor remains quiet, and a candle will burn clear in the bung hole. It is fined by isinglass. A pound being dissolved in about five gallons of cyder, a quart of this liquor is sufficient for a hogshead of cyder. Devonshire is famous for its *clouted* or *clotted* cream. This is made by placing the milk upon a broad iron plate, where it remains exposed to a gentle fire, till the whole of the cream is supposed to have risen to the surface. It is sold by the pound. Much butter is made from clouted cream; but the butter factors at Honiton will not buy butter made in this manner.

Cattle.

The southern boundary of the district of North Devon is justly celebrated for its breed of cattle; they are of the middle horned kind, but vary considerably both in size and form. Their permanent colour is a bright blood red. They are rather below the proper size for working cattle, but they possess great exertion and agility; they are not particularly good for the dairy. The cattle in West Devon are much inferior to those in North Devon; the latter, Mr Marshall supposes to be sprung from the native breed of the island. They are almost universally through the county used for agricultural labour. The Exmoor sheep are found in many parts of Devonshire; they are of the horned middle woolled class, though some are found *polled* or without horns. The Dorsetshire sheep are common in the Vale of Exeter. The native breed of horses resembles the Welsh and Highland breeds, and are very hardy and serviceable.

Rivers.

The principal rivers in this county, are the Taw, the Torridge, the Tamar, the Plym, the Yealme, the Arme, the Avon, the Dart, the Teign, the Ex, the Otter, and the Axe. The Taw rises in Dartmoor, and flows in a northerly direction till it reaches near Chumleigh, when it bends to the west; and receiving the waters of the Moule, it passes Barnstaple, and unites with the Torridge at Appledore. The Torridge rises in a high moor, on the northern part of Cornwall, not far from the Tamar; its windings are very numerous till it reaches the vicinity of Biddeford, where it becomes navigable for boats, and becomes a very rapid river; soon afterwards being joined by the Taw, it proceeds in a north-westerly direction, and falls into the Bristol Channel at Barnstaple Bay. The Dart, supposed to be so called from the rapidity of its current, rises in Dartmoor, and flowing rapidly southwards, passes Totness, after which it spreads into the arm that forms Dartmouth Haven. The origin of the Tamar is near that of the Torridge, not far from the Bristol Channel. It flows southward in a gently winding course, and becomes an arm of the sea at Plymouth Sound. The scenery on the banks of this river, from Plymouth to the Weir, about 22 miles, is uncommonly fine. The Teign rises in Dartmoor. It is composed of two branches, and its course is generally easterly. The country through which it passes is full of rocks till it reaches Bovey Tracey, after which it runs over flat, marshy ground, and falls into the sea at Teignmouth. The Ex, the Isca of Ptolemy, (evidently the same appellation as the Esks, rivers in Scotland, and derived from the Gaelic words which signifies *water*, and which is still retained in the term whisky,) rises in Exmoor in Somersetshire. Leaving this county at Dulverton, it proceeds by Tiverton to Exeter, widening, after it passes

Devonshire.

Topsham, into an arm of the sea, which terminates at Exmouth. The Tavy, the Plym, the Yealme, the Arme, and the Avon, all rise in Dartmoor. The Tavy falls into the Tamar, with which also the Plym unites in forming Plymouth Sound; the other three fall into the British Channel within a few miles of one another.

Roads and canals.

The roads in Devonshire are, in general, remarkably narrow, and by no means either well formed or well kept. Several canals have been projected in this county, but few carried into execution. Among the former, was one from Exeter to Crediton, and another from Barnstaple to Topsham. By a survey taken with a view to this last canal, it appeared that the low water line at Topsham, is 25 feet higher than the low water mark at the bridge of Barnstaple. A canal from the quay at Exeter to Cooley bridge has been lately executed; and one from Tavistock to the Tamar has been completed for some time.

Mineralogy.

The mineralogy of Devonshire presents some appearances worthy of notice. The chalk formation, which, on setting out from London, and going in a direct line from east to west, extends 150 miles, is lost on the road to Axminster, within 4 miles of Honiton. On leaving the chalk district, the transition country commences, of which Exeter may be regarded as the centre. Immediately after losing the chalk and flint, a red sandstone, with an argillo-ferruginous cement, succeeds. About Honiton, it is in the state of coarse-grained gravel; and near Exeter it assumes the character of an arenaceous sandstone. From Exeter, the red argillaceous sand-stone continues for some miles on the road to Plymouth. Near Chudleigh, it is succeeded by a vast number of flint pebbles; and between this place and Ashburton, a blue compact limestone, with numerous veins of calcareous spar, appears. In the neighbourhood of Ivy Bridge, the formation of the slaty and compact grauwacke commences; but on the shore near Plymouth, the cliffs are composed of limestone. The transition limestone, however, in its true character, is found on the left bank of the Plym, at the eastern end of the flying bridge. In ascending the valley of the Arme, the point of termination between the grauwacke and the granite is distinctly seen. The latter forms the primitive rock of the mountain plain of Dartmoor forest. It is a true granite, composed of felspar, quartz, and mica. About three miles from Tavistock, on the road from Twobridge, the grauwacke begins to reappear, in a very distinct manner, at the height of about 1129 feet above the level of the sea. Near the place where the roads join from Plymouth to Oakhampton, and from Tavistock to Twobridge, a bed of greenstone is found in the grauwacke slate; the latter contains more quartz, and becomes less slaty as we approach St Mary Tavy. The height of the line of superposition of the secondary on the primitive rocks, near Cullington, is 700 feet above the level of the sea; at Ivy Bridge hill, 631 feet; in the neigbourhood of Harford Church, Dartmoor forest, 1129 feet; and in the neighbourhood of St Mary Tavy, 648 feet.

Mines.

Tin, lead, iron, and manganese, are found in Devonshire, and also small quantities of gold, silver, copper, bismuth, antimony, and cobalt. Formerly the tin mines were abundant and profitable, now they are scarcely worth the expence and trouble of working. Lead ore is principally of a greyish blue colour. Some rich veins of this metal were discovered at Combe Martin a few years since. They run nearly from east to west, underlying towards the south; they are worked with very little trouble or expence, as they appear just below the surface of the ground. The galena has yielded from 20 to 168 ounces of silver per ton. Near Combe Martin is also found a mine of iron. The principal vein is, in many places, two inches thick, and is said to afford iron equal to that obtained in Wales. Considerable quantities of bog iron are found in the Moorlands. A mine of manganese was formerly wrought near Upton Pyne, but it has been filled up and another opened at Newton St Cyres. The matrix of the ore is the same at both places. The soil is a deep red clay. The deepest part of the mine is about 20 feet. The manganese does not run in veins, but is found in flat, irregular patches. From 150 to 200 tons are exported annually, principally to London. Copper mines are wrought at North Molton, in the parish of Brideston, in the neighbourhood of Tavistock, and at Buckland in the Moor. The mine near Tavistock, called Hawlfriendship, though not more than 23 fathoms in depth, has a rich vein of ore. The country round contains a great quantity of *killas*; and the matrix of the copper is a *caple*. The direction of the mine is from east to west; and the inclination to the north, about 5 feet in a fathom. The ore is generally sold in Cornwall, and smelted in Wales. Antimony has been found in the parishes of Chudleigh, Hennocke, and South Bovey; and cobalt, interspersed with filaments of silver, at Sampford.

Devonshire.

Mineralogy.

Limestone is found in abundance in many parts of Devonshire. In the eastern division of the county, it is soft, like chalk; but in the South Hams, and especially near South Molton, it is hard, with beautiful veins, and admits of a fine polish, so as to be denominated Devonshire marble. The finest kinds of Devonshire marble, however, are found in the district of North Devon. It has been lately much used, and a warehouse opened in London for the sale of it. Gypsum is found in a few places near Plymouth, united with limestone; and in other parts of the lime district, to the south-west of Exeter. About three and a half miles from Upper Pyne, the extraordinary substance, called Thorverton stone, is found. It is dug in a quarry to the depth of 40 feet, and is compact in proportion to its depth. There are three or four quarries all in the same rocks; a calcareous amygdaloid, the nature of which varies considerably. One part of the stratum exhibits an appearance extremely like toadstone. The granules are partly calcareous, partly argillaceous, and partly steatitical. In some places, the nodules are small, in others about the size of a pea. Some parts of the quarry have the appearance of porphyry, others are of a blackish colour, while others are intersected with narrow veins of white calcareous earth. A substance somewhat similar to Thorverton stone is dug out of Heavitree quarry near Exeter, but it is more coarse and loose textured, and approaches nearer to the nature of a breccia; the strata in this quarry are from six to eight feet in thickness, and dip south-east at an angle of about 15°. The stone dug from this quarry, hardens more and more by exposure to the air. The gates and walls, and most of the ancient edifices in Exeter, have been built of Heavitree stone; it is used for coarse millstones for sheeling clover. A kind of slate, called *Holland blues*, is got near East Alwington; and some good covering slates have been found at Lewtrenchard and Werrington. The Black-down hills afford a soft species of sandstone, which is converted into whetstones. A considerable quantity of brown potters clay is raised in the parish of Fremington, and conveyed to Barnstaple and other places, where it is used in the manufacture of the coarser articles of brown or common earthen ware.

Some years ago, a vein of culm was found near Chittlehampton, varying from about four inches to one foot in thickness; dipping to the south-ward about one foot in three. It was wrought for a short time, but the expence being very considerable, it was abandoned. In the extensive flat, called Bovey Heathfield, which seems to have been formerly covered by the tide, and to be below the level of the sea, that remarkable substance called Bovey coal is found. Its strata run nine miles to the southward, keeping to the west of the beds of potters clay in this neighbourhood. The uppermost strata rise to within a foot of the surface, and are from eighteen inches to four feet thick; the lowermost stratum is sixteen feet thick. Between the strata are beds of brownish clay, that diminish in thickness downward. At the bottom of the lowermost stratum of coal, there is also a bed of clay; below this is a bed of sand, and then clay again. The coal retains the vegetable structure, is of a black or blackish brown colour, with very much the appearance of charred wood; light, friable, easily split into irregular laminæ, and strongly impregnated with bitumen. It is divided into two kinds; the stone-coal and the wood-coal; the last has more of the peculiar properties of the Bovey coal than the former. When this coal is burning, a thick heavy smoke, of a fœtid and disagreeable nature, arises from it. The small coal, thrown into a heap, and exposed to the weather, will take fire of itself. Its specific gravity is from 1.4 to 1.558. Its proportion of pure carbon from 54 to 75 per cent. It has been carefully analysed by Hatchett, and his analysis will be found under the article Coal. Among the clay which divides the strata, but adhering to the coal, are found lumps of a bright yellow resinous earth, which is extremely light, and so completely saturated with petroleum, that it will burn like sealing-wax: if the burning is not carried too far, it produces an agreeable aromatic vapour. By analysis, it appears to contain, of resin 55, asphaltum 41, and earthy residuum 3. About two miles from the coal pits, *root* coal, having the form of roots, and *broad* or compressed coal, have been found, as well as in the coal pits. A strong appearance of the trunks and roots of the Scotch fir, may be traced in the *root* coal.

Bovey coal.

Fish.

Devonshire is remarkably well supplied with fish; the Tamar, Tavy, Exe, and Dart, abound in salmon of a peculiarly fine flavour; and the trout of the river Otter are highly celebrated. Besides these, Devonshire is celebrated for soals, plaise, and the John Doree (Zeus-faber). It is said, that the last never made its appearance at English tables, on account of its hideous appearance, till it was introduced by the celebrated epicure and comedian Quin. Another species of the Zeus (Zeus Luna,) is also sometimes found on the coast of Devonshire. This fish, commonly called the opah, or king fish, is not common on the British coast; one of them was taken at Brixham, near Torbay, in the year 1772. It weighed 140 pounds. It was four feet and a half in length, and two and a quarter in breadth, while its thickness was only four inches. The torpedo has been sometimes taken in Torbay, and in the river Dart; and the sepia, or cuttle fish, is not unfrequently caught in the nets of the fishermen off Teignmouth and the neighbouring coast. There are very large oyster-beds, said to cover 100 acres, at Starcross, Topsham, and Lympstone. It appears, by a grant of liberties from King John to the inhabitants of Devonshire, that the wolf was not extirpated at that time in this county; and a passage in Hooker would seem to prove that it existed here even so late as the reign of Elizabeth.

Natural history.

In the lanes leading to the village of Upton Pyne, an uncommon variety of *hieracium umbellatum* is found, which is described by Haller as "H. foliis pene ovatis, vix dentatis, caule humili, pene unifloro." In the neighbourhood of Thorverton quarries, *teucrium scorodonia,* (wood sage,) grows in great abundance, the fruit of which is used by the poor people instead of hops. *Linum angustifolium,* (narrow-leaved flax,) may be truly considered as a Devonshire plant; it decorates the road sides in great luxuriance between Ashburton and Totness. *Valeriana rubra,* (red valerian,) grows in the crevices of the stone of the old castle of Dartmouth; it is not uncommon, in such situations, along the western coast. *Campanula hederacea,* (ivy-leaved campion), is found on some of the large stones, which are sprinkled by the spray of the romantic water-fall of Lidford. *Lichen vulpinus,* with its lemon-coloured threads, adorns the old branches of oak and ash near Hartland priory; a place well worth visiting, on account of its romantic and agreeable scenery. On the shore near Hartland quay, *scilla verna* and *cochlearia danica* are found. On the eastern side of the haven of Teignmouth, there are some rare species of shells, especially *mactra lutraria,* (See Conchology, p. 93.) and *nerita glaucina.* Near Saltash, a species of *turbo* is found, which, though similar to *turbo littoreus,* (the common periwincle,) has some characters that seem to point it out as a different shell; it has a sort of distorted or rude contour, without any appearance of *striæ*; from this, and other circumstances, Dr Maton, who found it, is disposed to name it *turbo rudis.* Its colour is greenish. In the bay of Barnstaple, *asterias papposa,* (the *helianthemoides* of Pennant,) is found. Of the natural curiosities in Devonshire, the Valley of Stones is undoubtedly the most singular and curious. It lies about half a mile north west of Linton. The length of this valley is nearly a mile; its breadth at one end nearly 300 feet, but at the other end much narrower. It is entirely covered with immense masses of stone, thrown together sometimes in the grandest and sometimes in the most grotesque manner. The stones consist of a fine grained argillaceous grit; the fracture is lamellar; and in some instances the texture friable and loose. Some of the masses of rock are completely covered with turf, others are just acquiring a clothing of moss, while others again manifest only incipient traces of vegetation. The rocks between Torbay and Teignmouth have many considerable openings or fissures in them, of which the largest and most remarkable is *Kents Hole.* The depth of this cavern is about 682 feet. The roof of another cavern, which has three entrances, is nearly 30 feet high, and the length of it 130 feet.

Scenery.

There are many extensive and very beautiful views in Devonshire; indeed nearly the whole of the coast along the British Channel presents scenes, grand, picturesque, or beautiful; but the view from Mount Edgecombe is the most celebrated. This place lies near Plymouth, and commands a view, almost unequalled for variety and magnificence of objects. In front, the town and harbour of Plymouth; to the left, the dock yards and fortifications, with ships of various sizes, sailing in and out of the Tamar. On the right, the eye takes in the whole sweep of the channel, with several of the bold headlands, which start out from the coast. If the eye is turned to a nearer prospect, immediately below Mount Edgecombe, appears a fine declivity richly planted, and ornamented with statues, temples, and fountains. The view from Maken heights is still more extensive than that from Mount Edgecombe, but not equal to it in picturesque effect. Powderham castle should also be visited for its pictures, grounds, and romantic views; and the castle of Berry Pomeroy, for its magnificent ruins. Cromlechs, similar to those of Cornwall, are also met with in this county. Devonshire is not particularly distinguished for its manufactures. A few long ells for the East India trade are made at North and South Molton, and some other places. Coarse woollen serges are made at Totness, Moreton, Hempstead, Chagford, &c.; they are generally sent to Exeter to be dyed. At Tavistock, there are an iron foundery and cutlery on rather a large scale. In the neighbourhood of Kingsbridge, a liquor, called *white ale*, is brewed; a material called *grout* is put into it, but the nature of this is not known, except, it is said, to one family. White ale possesses a very intoxicating quality; it is of considerable antiquity, as the *tithe of white ale* is mentioned in the *terrier* of the advowson of Dodbrook. The principal exports from Exeter, &c. are cyder, woollen cloth, potters clay, and a prepared kind of fish called *Buckhorn*. Foreign produce is chiefly brought from London, and coals from Newcastle, Sunderland, and Wales.

Devonshire is esteemed a healthy county; the only endemial disease, is the Devonshire colica, (colic pictonum,) this prevails in the cyder districts, but whether from the solution of lead used in the vessels for making and keeping the cyder, or from ill-made cyder, drank in a recent state, is not known. Many superstitions still linger in this county, among which the most singular is that respecting the Pixies, a race of beings invisibly small, and harmless or friendly to man.

The original name of Devonshire is said to have been Dyvnaint or the country of Glens; the Belgæ had penetrated into it before the arrival of the Romans: in their time, this county and Cornwall were called Danmonium: under them, it was included in the district named *Brittannia Prima*. By the Saxons, it made a part of the kingdom of Wessex; and thus it continued till the incorporation of the Saxon heptarchy into one monarchy.

According to the returns of the population act, in 1811, Devonshire contained,

Inhabited houses	62,318
Families occupying them	79,415
Houses building	766
Houses uninhabited	2,475
Families employed in agriculture	33,044
Families employed in trade, &c.	30,977
Families not comprised in these classes	15,394
Males	179,553
Females	203,755
	383,308
In 1801	354,400
Increase	28,908

See Vancouver's *Agricultural Survey of Devonshire*; Polwhele's *History of Devonshire*; Maton's *Observations on the Western Counties of England*; Dr Berger *on the Physical Structure of Devonshire and Cornwall*, in the *Geological Transactions*; Marshall's *Rural Economy of the West of England*; *Beauties of England and Wales*, vol. iv. (W. S.)

DEUTZIA, a genus of plants of the class Decandria, and order Trigynia. See BOTANY, p. 217.

DEW. See METEOROLOGY.

DE WITT, JOHN, the celebrated Dutch statesman, was born on the 25th September 1625. His father, James De Witt, was a man of considerable learning and capacity, and held, during several years, the office of burgomaster of the city of Dort.

John De Witt was distinguished, at an early age, by his love of the sciences, and made a rapid progress in his studies. Jurisprudence, political economy, and the mathematics, principally engaged his attention; and he soon exhibited sufficient proofs of his proficiency in the last of these sciences, in his work, entitled, *Elementa Curvarum Linearum*, which was published when he was only 23 years of age. Having finished his academical studies, he took the degree of Doctor of Laws, and afterwards travelled, for some years, in foreign countries. Upon his return, in 1650, he was appointed pensionary of Dort; and after the death of Adrian Paauw, he was chosen pensionary of Holland and West Friesland, intendant of the finances, and keeper of the great seal of these provinces.

The history of the public administration of this distinguished statesman will be given, for the sake of connection, in the article HOLLAND. During nearly 20 years of the most flourishing æra of the United Provinces, he stood at the head of the government of his country; and, by his eminent political talents, contributed to elevate her to a high station among the European powers. By his skilful management, during that period, he contrived to stifle the hopes and pretensions of the Orange party, to preserve a spirit of union among all the provinces, to replenish the treasury, and to equip a fleet which was able to cope with the navy of England.

De Witt was a zealous advocate of peace, and strenuously opposed the war with England in 1652. In the treaty of peace which was concluded with Cromwell, an article was inserted to exclude the Prince of Orange, and his posterity, from the offices of stadtholder and captain-general; an article which excited considerable discontent among the Dutch, and tended to render the minister unpopular. He was, however, reelected pensionary of Holland in 1663. In the war with England, which soon afterwards ensued, he was appointed one of the commissioners to superintend the navy; and he was subsequently joined with two other individuals in the command of the fleet; in which situation he greatly distinguished himself by his gallantry and tactical skill, and received thanks for his services.

In spite of the great talents and influence of the pensionary, the Orange party daily gained new ground; and considerable commotions were excited, throughout several of the provinces, in favour of the young prince. By the *perpetual edict*, enacted by the states of Holland, in the year 1667, no Stadtholder was ever in future to be appointed in Holland; and no Stadtholder of any of the other provinces was ever to have the vote of Holland, at the election of a captain-general of the union. But the measures adopted by De Witt to secure the republican form of government, were entirely disconcerted, in consequence of the invasion of the United Provinces by the French monarch, Louis XIV. The distresses occasioned by the war were severely felt, and the popularity of the minister daily declined. The command of the army was immediately conferred upon Prince William of Orange; and the magistrates throughout Holland were soon compelled by the people to acknowledge him as Stadtholder. The pensionary himself was attacked by four assassins, and left for dead in the streets. At the same time, his brother, Cornelius, was falsely accused of an attempt on the life of the Prince of Orange, and condemned to suffer the question. He endured the most excruciating tortures with an heroic fortitude; and, in the midst of his agonies, repeated, as applicable to his own situation, the well-known ode of Horace, beginning,

Justum et tenacem propositi virum, &c.

The judges were confounded by the unshaken courage he displayed: his life was spared, but he was sentenced to banishment. The pensionary resigned his office, and followed his brother to prison. The mob immediately assembled round the spot, obtained admission into the prison, dragged away the two brothers, whom they inhumanly murdered, and afterwards exercised upon their dead bodies every species of indignity which the fury of the moment could suggest.

John De Witt was unquestionably one of the ablest men of his age. He excelled in bodily exercises, and possessed an intimate knowledge of the liberal arts and sciences. He was a skilful politician, vigilant in his administration, and indefatigably laborious in business. His deportment was modest and serious; and although far from courting popularity by illiberal condescensions, he was, at all times, affable and easy of access. He possessed a firmness and magnanimity of character, which rose superior to difficulties and dangers; an irreproachable integrity, and a disinterested attachment to what he conceived to be the true interests of his country. See *Histoire de la Vie et de la Mort des deux Illustres Freres, Corneille et Jean de Witt*, Utrecht, 1709; and Sir W. Temple's *Remarques sur l'etat des Provinces Unies des Pays-bas*, Utrecht, 1697. (*z*)

DEZIMA. See DISSIMA.

DHALAC, DAHALAC, or DAHLAK, the largest island in the Arabian Gulf, is situated about seven miles from the eastern coast of Abyssinia, between the parallels of latitude 15° 32′ and 15° 5′ north, and the parallels of longitude 40° 3′ and 40° 17½′ east. Its greatest length from north-west to south-east is about 37 miles, and its greatest breadth 18 miles.

The surface of the island is low and flat, without any hills or mountains; and the soil is fixed gravel and white sand, containing shells and marine exuviæ. About three miles to the south-east of Dhalac-el-Kibeer, the rocks rise into a remarkable cliff, not less than 30 feet high. The strata lie horizontally, and are so regular, that they appeared to Mr Salt, even when he was near them, to resemble the walls of an ancient castle. Excepting one or two valleys, where there is some verdure, the island is destitute of all sorts of herbage, but a little bent grass, which affords a meagre sustenance to the goats and antelopes. Large plantations of acacia trees occur in different parts of the island.

The climate of Dhalac differs materially from that of Abyssinia. No rains fall from the end of March to the beginning of October; but in the other months, particularly December, January, and February, there are violent showers, that continue for twelve hours, and fill the cisterns, which supply the inhabitants with water. The following heights of the thermometer were taken by Mr Salt:

January 1807	80°	morning.
——	87	noon.
January 1808	80°	noon.
1808	87	
1809	80	at daylight.
——	90	at night.
1811	82	noon, cloudy.
1812	82¼	
1813	84	

Mr Bruce informs us, that there are 370 tanks or cisterns in the island, hewn out of the solid rock, and capable of supplying with water any British fleet which could be sent into the Red Sea. He supposes that they were erected by the munificence of the Ptolemies, although they are ascribed, by tradition, to the Persians. Lord Valentia has contradicted this statement in the most unqualified terms: "The three hundred and seventy cisterns," says he, "all hewn out of the solid rock, have, after the most minute investigation, been reduced to less than twenty; and of these not one is to be found at Dobelew, where Mr Bruce asserts as an eye-witness, that they are neglected, and open to every sort of animal, and half full of the filth that they leave there, after drinking and washing in them.

This island contains about twelve villages or towns, the principal of which are, Dhalac-el-Kibeer, Dobelew, Gerbeschid, Saied-el-Ait, &c. Dhalac-el-Kibeer was once the principal port in the island, and it still exhibits many marks of its former importance. The town is about half a mile from the sea, and is separated from it by a sloping beach of sand. The harbour is almost surrounded by a chain of nine islands, at the distance of about two miles. On the northern side of it are the ruins of two small stone mosques, with round cupolas at top. A great number of monumental stones are placed erect on the ground around the mosque, and at the head of the tombs to which they belong. Some of them are well carved, and beautifully decorated with flowers, &c. The characters being sometimes in the Cufic, and sometimes in the Arabic, Mr Salt copied several of the inscriptions, which are given in the second volume of Lord Valentia's Travels. One of those stones, which was held in the highest veneration, belonged to the shiek who built the tanks. It is opposite to the principal mosque, and is kept by the natives constantly moist with oil.

About twelve of the tanks at Dhalac-el-Kibeer were nearly of the same construction. One of them was square and uncovered, and the largest would hold about 150 tons. They were excavated from the solid rock, and were chunamed, but not lined with stone. In another tank the roof was supported by five pillars. Its longest diameter was 24 feet, its shortest 22, and the pillars were six feet in circuit, and the interval between each was six feet; but some of the pillars were two feet, and others four feet distant from the wall. They had no distinct capital, but were thickest at the top. This tank was thirteen feet deep, and the whole was covered with chunam.

The village of Dobelew is fully as large as Dhalac-el-Kibeer. It has a white tower at the east and west ends, and two of a smaller size on the north. Bruce says, that it consists of 80 houses, covered with bent grass, built of calcinable stone, brought from the sea. The harbour, which is three miles north-east of the town, is represented by Bruce as having a circular form and a narrow entrance, but full of rocks, consisting of ramifications of white coral, intermixed with large black stones. Lord Valentia, on the contrary, Dhalac.

observes, "that the round harbour of Dobelew, and its narrow entrance, are no where discoverable; and the town itself, instead of being three miles S. W. of the harbour, is, in fact, on a parallel with the northern extremity of Irwee, which forms the harbour, and is an island."

At the distance of four and a half miles from Dobelew stands Gerbeschid, which consists of about twenty wretched huts, about three miles distant from the sea. A considerable quantity of cheese is exported from this place to Loheia. The island of Irwee contains a small village, which is visited by fishermen in catamarans. The coast is low, with a few trees scattered up and down; and the sea between it and Dobelew is shallow, and full of shoals.

The inhabitants of this island are a simple and an inoffensive people, and are employed almost solely in working the vessels, which trade to the different parts of the coast. Fish is the principal source of their subsistence; and in some of the villages, which are not visited by the Arabian boats, the inhabitants will sometimes live a whole year without tasting bread. The women are excellent fishers. They have, in general, a brown complexion, but are sometimes of a reddish hue, a little darker than the colour of new mahogany. The language of the inhabitants is that of the "Shepherds," though Arabic is also generally spoken.

Dhalac is dependent on Massowah. A goat brought every month from each of the twelve villages constitutes the principal part of the revenue of the governor. Every Arabian vessel also brings him a dollar or pataka; and every vessel from Massowah contributes a pound of coffee. Venetian glass beads are the only money current in the island.

Dhelly || Dial.

The valuable fisheries for pearls and tortoise shells, which were formerly carried on in the Red Sea, extended from Dhalac to nearly the latitude of 20°; and the divers and fishers were principally obtained from that island. Under the Ptolemies, it was successfully carried on. It was afterwards rented to the Basha of Suaken; but when it became dependent on the Basha of Jidda, the Aga, whom he appointed, appropriated to himself the provisions and salary which were allotted for the fishery. The pearls found here are of the largest size, and of the finest kind; and the tortoise shells, which were carried to the East Indies and China, were esteemed the finest in the world. See Bruce's *Travels in Abyssinia*, vol. i.; and Lord Valentia's *Voyages and Travels*, vol. ii. chap. i. and v. (π)

DHELLY. See TIMOUR.

DIABETES. See MEDICINE.

DIADELPHIA. See BOTANY, p. 76. and 272.

DIALIUM, a genus of plants of the class Diandria, and order Monogynia. See BOTANY, p. 90.

DIAL, an instrument generally so constructed as to show the hour of the day by the solar shadow of some opaque body falling on a system of lines traced on a surface. Sometimes the surface is a horizontal plane, and then the instrument is called a *horizontal* dial. The surface of a dial, however, may be of any figure whatever, and may have any position; and hence the various kinds of dials, as *horizontal, vertical, polar, equatorial,* &c. the principal of which will be found explained in the article DIALLING. (ξ)

DIALLING.

History.

1. DIALLING, or the method of constructing sun dials, is a branch of mixed mathematics, which depends partly on the principles of geometry, and partly on those of astronomy.

Definition.

This branch of mathematical science was called by the Greeks and Romans *Gnomonica*, also *Sciaterica*, from Γνώμων *an index*, and σκία *a shadow*. It has also been called *Photosciaterica* from φως *light*, and σκία *a shadow*, because the hour is sometimes indicated by the light of the sun, as when it passes through a small hole, and falls on the dial. Again, it has been called *Horographia*, because it is the art of writing the hours; also *Horologiagraphia*, because sun dials were formerly called *Horologia*; they were also named *Sciaterica*.

History.

2. As the division of time is a matter of great importance, this branch of knowledge must have early engaged the attention of mankind. It appears that the ancient Jews had instruments for measuring time by shadows; for it is recorded in scripture, 2 Kings, chap. xx. and Isaish, chap. xxviii. that, by a miracle, the shadow went back ten degrees on the sun dial of Ahaz, as a sign given to Hezekiah that he should recover when he was "sick unto death." This happened 113 years before the Christian era.

3. The nations of antiquity differed greatly from us in their mode of reckoning time; we know, that first the rising and setting of the sun were the circumstances which determined the length of their day. The Babylonians began the day at sunrise, and reckoned it to continue until the next following sunrise. The Athenians, again, considered the interval between any sunset and the next following, as forming their day, which they divided into two portions; the natural night extending from sunset to sunrise, and the natural day from sunrise to sunset. It is probable that the Egyptians reckoned time in the same manner; but as they cultivated astronomy long before the Greeks, they must have earlier felt the inconvenience of this manner of reckoning time, and thence have been led to begin the day at noon.

History. Origin of dialling.

4. The Egyptians and Babylonians were the first that could determine correctly the position of the meridian. The former have shewn their skill in resolving this problem, by placing the pyramids in the direction of the cardinal points; they are also reckoned to have been the first who divided the day into 24 equal parts: but it is certain that they were one of the earliest people who divided the duration of the day into equal parts, whether astronomically or mechanically, and this was long before the Greeks had reached the same degree of refinement in reckoning time. Although this last nation employed the word Ὥρα from the remotest antiquity, yet it did not indicate a division of the day, but a season, an indeterminate portion of time. Until the period that philosophy was cultivated among them, the only circumstances of the day that they noted, were the rising and setting of the sun, and the time of noon found vaguely, as by the light of the sun falling upon, or leaving the face of some edifice. As to midnight, it could only be determined by a rough estimation.

5. When Greece became enlightened by philosophy, geometry, and astronomy, this last science furnished

History.

the means of dividing time with more accuracy. The first step was doubtless the astronomical determination of noon; an invention which Diogenes Laertius has attributed to Anaximander, the successor of Thales, who erected a gnomon or pyramid, about 600 years before the Christian era. This instrument shewed the time of noon, either by the shortest shadow, or by its falling on a meridian line. It is probable that Anaximander received this invention from his master Thales, who may have learned it in Egypt, where he studied. Pliny has given the merit of it to Anaximenes. Certainly one or other of these philosophers gave the first sun dial to the Lacedemonians; and as the progress of discovery is, in general, slow, it may be that all the three may have had some share in the invention.

Origin of dialling among the Greeks.

6. Herodotus, however, gives a different account of the origin of dialling among the Greeks. According to him, they received the *Pole*, and the *Gnomon*, and the division of the day into 12 parts, from the Babylonians; and this accords very well with what is stated by other ancient writers, namely, that Berosus, a Chaldean, founded a school at Cos, where he taught the sciences cultivated in his own country. Vitruvius attributes the construction of a kind of dial to a philosopher of this name; and it was probably he that taught to the Greeks the construction of sun dials, and the division of the day into 12 parts. Certain circumstances render it probable that this philosopher lived nearly 540 years before Christ, or about the time of Anaximander and Anaximenes.

7. The manners of the Romans appear to have been but little favourable to the cultivation of the mathematical sciences, and accordingly it was late before that nation adopted any thing like a tolerably accurate method of dividing time. Even in the middle of the fifth century, after the building of Rome, the only periods of the day noted, were the rising and setting of the sun, and mid-day; which last was proclaimed by a herald when he saw the sun from the senate house, between the *Rostra* and a place named *Græcostasis.*

Roman dials.

It has been said that the first sun dial known at Rome was placed near the temple of Quirinus, by the directions of Lucius Papirius Cursor, about the year of the city 460, in order to fulfil a vow made by his father. However, Pliny, who relates this circumstance, doubts it; and shortly after states that the first sun dial was set up near the *Rostra*, about 30 years later, during the first Punic war, by the consul Valerius Messala, who brought it from Catania in Sicily after the taking of that city. This dial, however, measured time imperfectly, because it was made for a latitude considerably different from that of Rome. Yet it was used for a period of 99 years; and at last the consul Martius Philippus, about the year of Rome 590, caused another more exact to be constructed, probably by some Greek, for the Roman arms had then penetrated into Greece. The Romans, however, were still without the means of measuring time in cloudy weather and during the night, until about a century afterwards, when Scipio Nasica procured a *Clepsydra* to be constructed, which was perhaps also the work of some Greek; for Hero and Ctesibius, who lived under the first Ptolemies, were the inventors of this ingenious machine.

8. Sun dials, or *Horologia*, are frequently mentioned in the writings of antiquity. Menander has introduced into one of his pieces, a hungry parasite who had watched on a dial the arrival of the shadow at the hour of a repast; but in his eagerness, he had begun so early as to mistake the light of the moon for that of the sun. It is related, that a sun dial having been shewn to Epicurus, he exclaimed, "What a fine invention to hinder us from forgetting to dine!" The Greek anthology has preserved a humorous inscription placed on a sun dial, the meaning of which is, that *six hours of the day are given for labour, the remaining four say to mortals, live;* these hours being marked on the dial by the Greek letters Z, H, Θ, I, which may be supposed to form the word ZHΘI, *live.*

9. Aulius Gellius has preserved, in his Attic Nights, a curious fragment of a comedy of Plautus, in which a parasite exclaims against sun dials in these terms:

> "Ut eum dî perdant, primus qui horas reperit,
> Quique adeo primus statuit hic solarium,
> Qui mihi comminuit misero articulatim diem.
> Nam me puero uterus erat solarium.
> Multo omnium istorum optimum ac verissimum:
> Ubi iste monebat esse nisi cum nihil erat:
> Nunc etiam quod est, non est, nisi soli lubet.
> Itaque adeo jam oppletum est oppidum solariis,
> Major populi pars avidi reptant fame."

"May the gods confound the fellow who first invented hours, and placed the dial here, which doles out the day piecemeal to me, an unhappy wretch! For when I was a boy, my belly was my dial, and it was by far the best, and truest of them all: I ate whenever it warned me, that is, if any thing could be had; but now, whatever there may be, it is not, unless forsooth it pleaseth the sun: Indeed, since the town was filled with dials, the greater part of the people crawl about starving with hunger."

10. Modern dials, in general, indicate the hour by the position of the shadow on a plane; but there is reason to suppose, that some of the ancient dials shewed the hour by the length of the shadow; and that even the human body was made, in this way, to serve the purpose of a dial. This mode of determining time, however, had the inconvenience of requiring a table of numbers, to shew the length of the shadow at every hour for different times of the year. An ancient calendar has been preserved by Palladius, a writer of the sixth century, which contains a table of this kind, shewing the length of the shadow for every hour of the day at the end of each month.

Ancient dials.

11. Vitruvius has preserved, in his writings, the only notices that have come down to our times respecting the different kinds of ancient sun-dials, and their inventors. According to him, Berosus the Chaldean was reputed the inventor of the dial called *Hemicycle*, hollowed into a square, and adapted to the climate. Aristarchus of Samos invented the *Scaphe*, or hemisphere, as well as the *Discus*. Again, Eudoxus of Cnidus, or, according to others, Apollonius, contrived the *Arachne*, or *Aranea*: Scopas of Syracuse made the *Plinthium*: The *Pros-ta Istoroumena* was the work of Parmenion; and the *Pros-panclima* that of Theodosius and Andreas: Patrocles was the inventor of *Pelecinon*, or *Bipennis*: Dionysidorus of the *Cone*, and Apollonius of the *Pharetra*. He enumerates the names of other dials, viz. the *Gonarche*, the *Engoniaton*, and the *Antiboreum;* and we also learn from him, that there were portable dials (*viatoria pensilia*), concerning which different authors had written, and the description of which, he says, depends on the *Analemma*, which he had previously described.

Aristarchus' dial.

12. Of these dials, that of Aristarchus probably was the most simple. It was a hemisphere cut in a cubic

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block of stone, having its base horizontal. At the bottom of the cavity, a style was erected, the top of which was at the centre of the sphere. It is easy to see that the summit of the style would describe every day an arc of a circle at the bottom, similar to the diurnal parallel described by the sun. The equator and tropics would be easily delineated on the inside of the hemisphere, and these being divided into twelve equal parts, curve lines drawn through the divisions would be hour lines, and would divide into 12 parts the trace of the style, and the entire day from sunrise to sunset. Several antique dials of this kind have been found; the first in 1741, in the ruins of an ancient Roman house, situated on Tusculum, which appears to have belonged to Cicero, so that the dial is valuable both on account of its antiquity, and its having belonged to the Roman orator, who seems to have referred to it in one of his letters to his freedman Tiro. It was placed in the museum of the Roman college, and described in 1746 by P. Zuzzeri, a learned jesuit. We have given a figure of it in Plate CCXXVIII. Fig. 1; and it may be remarked, that the useless part of it has been cut off by a plane parallel to the equator and the tropics of the dial. This plane has been found to be inclined to the earth's equator at an angle of 48° 17′ or 18′; now this is precisely the inclination of the horizon of Tusculum to the equator, which shews that the dial has been made by an intelligent person.

Cicero's dial.

Plate CCXXVIII. Fig. 1.

A dial of the same construction was discovered in 1751, at *Castel-Nuovo*, in the ecclesiastical state, and was placed by Pope Benedict XIV. in the museum of the capital; and another was disinterred the same year about the same place. These exhibit in their cavity not only the hour circles, but also the equator and the tropics. A third was found in the ruins of Pompeii, but this differs from the others in having only the hour lines and equator.

13. The figures of some antique dials have been preserved on the monuments of antiquity. Gabriel Simeoni has described one which accompanied a calendar. It was a triple dial, the middle one traced on a concave cylindric surface, and the two lateral ones on plane surfaces. There was formerly a dial at Ravenna, which had the figure of a hemisphere supported on the shoulders of a Hercules: it was turned towards the south. Lambecius has also preserved the figure of a dial supported on a column. He copied it from a very ancient manuscript in the imperial library. It wants the upper part of the hemisphere, which would have been useless, because the shadow of the extremity of the stile passes only over the inferior part.

14. A very curious portable dial was dug out of the ruins of Portici in 1755, and described in the preface to the third volume of the description of representations found in the ruins. Its shape is that of a bacon ham; and it is suspended to a ring fastened to the leg. The end of the tail, which has been preserved, serves as a stile. Its figure is shewn in Plate CCXXVIII. Fig. 2. The hours are marked on that part of the surface which is nearly plane. There appears to be seven vertical lines intersected by as many others, and below these intervals the names of the months are written. Such as understand dialling will readily see how this dial is to be used. It must be suspended by the ring, and turned slowly round, until the shadow of the top of the stile fall upon the line of the month, the hour will then be indicated by the nearest transversal line.

Plate CCXXVIII. Fig. 2.

15. The theory of sun dials must have been cultivated among the Arabians along with the sciences of mathematics and astronomy, upon which it depends, during the period when Europe was enveloped in the darkness of ignorance; and some manuscript treatises of their astronomers on this subject are to be found in the repositories of literature. In the Bodleian library, there is a treatise on sun dials by Takioddin Ibn Marysh, who lived about the year 1579; and it contains others by Abul-Hazen de Maroc and Mohalled. Their celebrated philosopher Jacob Alkendi, has also written on shadows; and it was probably a treatise of his on sun dials that was called *Sciotherica.*

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The necessity of a method of dividing time, has induced even the Turks to attend to this subject. One of their astronomers, Mustapha ben Ali, who lived about 1533, has written a treatise on sun dials, and the division of time.

16. Upon the revival of learning in Europe, the science of gnomonics was again cultivated, and treatises were composed on the subject by John Stabius, Andrew Stiberius, and John Werner, astronomers of the 15th century; but they have remained in manuscript. To these may be added John Schoner, an astronomer of the beginning of the 16th century, who published in 1515 a work called *Horarii cylindri canones,* where he teaches the construction of cylindrical dials. His other gnomonical works were afterwards published by his son. Other early writers on this subject, were Munster and Orontius Fineus. The first of these published at Basil in 1531, a work called *Compositio horologiorum in plano muro,* &c. and the latter brought out in 1532, his work *de Horologiis solaribus et quadrantibus,* libri iv. Among the gnomonists of that age may be rekoned Vinet and Bullant, who have written in French. The Chartreuse John Bat. Vico Mercati, who lightened his solitude by writing his treatise *Degli horologi solari.* Commandinus, whose work is called *de Horologiorum descriptione,* and who afterwards published an edition of the *Analemma* of Ptolemy. Maurolycus, whose treatise *de Lineis horariis* appeared in 1575. Paduanus of Verona *de compositione et usu multiformium horologiorum.* Valentino Pini, J. B. Beneditti or de Benedictis, who published a treatise *de Gnomonum umbrarumque solarium usu* 1574; and Clavius the jesuit, whose *Gnomonices, libri viii.* appeared in 1581 and 1599.

17. The Portuguese astronomer Nonius, deserves to be mentioned here, on account of his having noticed and explained the phenomenon of the retrogradation of the shadow on a dial in certain latitudes. Some have supposed that it was in this way the shadow went back on the sun dial of Ahaz, but this explanation seems quite inadmissible.

18. The 17th century produced a multitude of works on dialling in all languages, and suited to all capacities, from the geometer, who required merely the theory in order to see at once all its applications, to the stone mason, who, ignorant of its principles, could only follow practical rules. The principal writers of this age were Muzio Oddi *Degli Orologi Solari* (*Mil. & Ven.* 1611 and 1638, in 4to.); Kircher, *Ars magna lucis et umbræ*; P. Maignan, *Perspectiva horaria,* lib. iv. (Rome 1646 in fol.); Deschales in his *Cursus Math.* (Ludg. 1674 and 1690, in fol.); Forster, *The art of dialling,* &c. (Lond. 1638, in 8vo.); Collins' *Description and use of a great universal quadrant,* (Lond. 1658); Desargues, *La methode de Gnomonique,* (Paris 1641, in 4to.); De la Hire, *Gnomonique,* (Paris 1681, in 8vo.); Ozanam, *Gnomonique,* (Paris 1673, in 8vo.); Wells'

Art of Shadows, (Lond. 1635); Leybourn, *Dialling, Plane, Concave, Convex, Projective, Reflective, Refractive*, &c. (second edit. Lond. 1700, fol.)

Among the writers of the last century, we have Don Bedos de Celles, *Gnomonique Pratique*, (Bord. 1750, in 8vo.); Gruber, *Horographia trigonometria*, (Prag. 1718); Rivard, *Gnomonique*, (Paris, 1742, in 8vo.); Casbroni *Horographia Universalis*, (1730); Leadbetter, *Mechanic Dialling*; W. Jones, *Instrumental Dialling*; Emerson, *Dialling*, (1770, 8vo.); Hutton's *Translation of Montucla's Mathematical Recreations*, vol. iii. (1803); Dr Brewster's edition of Ferguson's *Lectures*. Writers on the sun dials of the ancients, are Zuzzeri, *D'un ant. villa scopertu sub doso del Tusculo ed un antico orologio a Sole tra le ruinæ della ritrovato*, (Venez. 1746, in 4to.); George Henri Martini, *A treatise concerning the Sun Dials of the ancients*, (in German); and Ernesti *De Solariis*. Some have composed tables, in order to abridge calculations on dialling. In this class of writers may be reckoned Hyppolite Saladio, *Tabulae Gnomonicae una cum earum usu et fabrica*, (Rom. 1617, in 4to.); Dominico Lucchini, *Tratenimenti mathematici*, (Rom. 1630, in 4to.); Grov. Lud. Quadri, *Tavali gnomoniche*, (Bol. 1733, in 4to.); the Prince Caraffe della Roccella, *Exemplar horologium solarium civilium*, (Mazzareni 1686, an enormous folio.)

The theory of dialling has sometimes been treated as a branch of perspective, as by Sgravesand in his *Essai de Perspective*, (Amst. 1711, in 8vo.); and Dr Horsley in his *Tracts on the Projection of the Sphere*, (Oxford, 1801, in 8vo.) The subject has also been treated as a branch of Analysis by Kaestner in his *Gnomonica Universalis Analytica*, (1754, Lip. in 4to.); M. M. Dionis du Sejour and Godin, in *Recherches Gnomoniques les regradations des planetes et les Eclipses du Soleil*, (Paris, 1761, in 8vo.)

Of late, the French mathematicians have referred the theory of dialling to what they call *Descriptive Geometry*; and in this way the subject has been treated by Hachette in his *Cours de geometrie descriptive*; Lefrançois in *Journal d'Ecole Polytechnique* IIe *Cahier*; and Berroyer in his *Gnomonique ou theorie des cadrans solaries*, given among the additions to the second edition of Biot's *Astronomie Physique*, tom. iii.

In the following treatise, we shall, in general, explain the principles of this theory, and the construction of dials, in a manner strictly geometrical. As, however, there may be some of our readers who wish to make dials, and yet are not sufficiently skilled in geometry to comprehend fully the theory, we shall give practical rules for delineating the most useful kinds, employing only the common problems of elementary geometry.

The General Principles of Dialling.

General principles of dialling.

19. The principles of astronomy teach us that the earth moves in an orbit about the sun, and completes a revolution in a year; while, at the same time, it revolves uniformly from west to east on its axis, which, although it changes its place, is yet always parallel to a fixed imaginary line, called the axis of the world. By the first of these motions, the sun appears to move round the heavens, completing a revolution in the course of a year; and by the second, the sun, and all the heavenly bodies, have an apparent diurnal motion about the earth from east to west.

20. The motion of the earth in its orbit is not equable; and hence it happens, that the apparent motion of the sun in the heavens is not quite uniform: besides, the plane of that motion does not coincide with the plane of the diurnal motion. On these two accounts, the apparent diurnal motion of the sun differs a little from uniformity, as is particularly explained in Astronomy, p. 652.

21. In the theory of dialling, however, we are to suppose that the sun's diurnal motion is always perfectly uniform, and that it moves throughout the day in a circle parallel to the equator; but as neither of these hypotheses is strictly true, the time of the day shewn by a dial will in general differ from that shewn by an accurate clock. However, the difference admits of exact estimation, and tables have been calculated which shew its amount for every day throughout the year. See Astronomy, p. 653.

22. In constructing dials, it is also usual to leave the effect of refraction out of consideration; its effect might indeed be exactly appreciated, and tables formed by which the time indicated by the dial might be corrected; or the dial might even be so constructed as to give the time cleared from the error. But this would be a degree of refinement which may very well be overlooked in the practice of what, since the invention of clocks and watches, is now little more than a scientific recreation.

23. If the earth's radius had any sensible proportion to its distance from the sun, that ought to be taken into account in the construction of dials. But the earth is almost a mere point, as seen from the sun; and hence it happens that the diurnal motion of the sun about any line on the earth's surface, which is parallel to its axis, may be accounted uniform, exactly as if it were performed about the axis itself.

24. To understand the nature of a dial, let us suppose that *e*EF (Fig. 3.) is a straight rod or wire, parallel to the axis of the earth; or which, if produced, would pass through the pole of the heavens; and let us suppose that one of its extremities terminates at *e* in a plane, *a b c d* having any position whatever. Let us farther suppose, that the wire passes through E, the centre of a circle ABCD, described on some solid substance, and that it is perpendicular to the plane of that circle: Then, as the wire passes through the poles of the heavens, the circle ABCD will be parallel to the terrestrial equator, and it will be in the plane of the equinoctial circle in the heavens, because on the earth's surface any plane whatever, parallel to the equator, may be considered as coincident with it, when produced to the celestial sphere. Plate CCXXVIII. Fig. 3.

Now, because the axis of the earth is perpendicular to the plane of the circle which the sun appears to describe in the heavens by his diurnal motion, and passes through its centre, and that the same is almost exactly true of every line parallel to the earth's axis; when the circle ABCD is illuminated by the sun, the wire EF will project a shadow upon it, which will revolve about E as a centre, passing over equal arcs of the circumference in equal intervals of time. If, therefore, we suppose the circumference of the circle to be divided into 24 equal parts, and the points of division to be numbered 1, 2, 3, 4, &c. to 12, and again 1, 2, 3, 4, &c. to 12, as in the figure, and the circle to have such a position, that the shadow falls upon E 12 at noon; then, at one o'clock, it will have the position E 1; at two o'clock, it will have the position E 2; at three, the position E 3; and so on. In short, the hour of the day, from sunrise to sunset, will be indicated by the shadow, just as it is shewn upon a watch by the motion of the hour hand. And as we suppose the motion of

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the sun to be quite uniform, the shadow will always have the same position at the same hour every day throughout the year.

25. If the two planes ABCD, *a b c d* are illuminated at once by the sun, the rod *e* EF will project a shadow on them both. Let us suppose that at the instants the line EF projects its shadow in the directions of the lines E 12, E 1, E 2, &c. on the upper plane, the shadow of *e* E falls in the lines *e* 12, *e* 1, *e* 2, &c. respectively on the lower plane; and let other cotemporaneous positions of the shadows be found for every hour the sun can shine on the planes; then, as the shadow will always come to the same position on each plane at the same hour of the day, the hours will be indicated also by the shadow on the plane *a b c d e*.

26. Each of the planes ABCD, *a b c d* is a *dial*: we have supposed the upper plane to be perpendicular to the axis of the world; and in this particular position, the shadow will describe equal angles on it in equal times. The plane of the dial may, however, have any position; but if it is not perpendicular to the earth's axis, the motion of the shadow projected on it will not be uniform, as it is on the plane of the equinoctial.

27. The rod EF, which projects the shadow, is called the *Style*; also sometimes the *Axis* of the dial.

The lines E 12, E 1, &c. which indicate the position of the shadow at the different hours, are called *Hour Lines*. The hour lines are evidently the common section of the plane of the dial, and a plane passing through its axis and the sun.

The point in which the axis of a dial meets its plane, which is also the common concourse of the hour lines, is called its *Centre*. There are other technical terms belonging to this subject, but these we shall explain as we proceed.

28. The latitude of the place for which a dial is to be made, is an important element in their construction. This may be known by good maps, or it may be determined by astronomical observations, as is particularly explained in our article Astronomy, p. 665.

How to trace a Meridian Line on any Plane.

Method of drawing a meridian line.

29. In constructing a dial, it is always necessary to determine the line in which the plane of the meridian meets the plane of the dial. If the plane of the dial is not horizontal, it will be convenient, in the first place, to trace a meridian line on a horizontal plane near it. In our article Astronomy, p. 653, we have explained one way of doing this, by two equal shadows of a pin perpendicular to the plane. A meridian may also be found by any three shadows of an upright pin or style. Let OV (Fig. 4.) be the style which stands at right angles to the plane in O, and OA, OA′, O′A″ its shadows at three different times of the day. Then, if AV, A′V, A″V be joined, the angles AVO, A′VO, A″VO are the sun's distances from the zenith at the times of noting the positions of the shadows; and these are known, because in the right angled triangles AOV, A′OV, A″OV, the sides about the right angles at O are known, from which the angles at V may be found.

Plate CCXXVIII. Fig. 4.

Let us now suppose that the sphere is projected stereographically on the horizontal plane AA′A″, so that O is the centre of the primitive, the eye being in the nadir, then the lines AO, A′O, A″O produced will be the projections of azimuth circles; if the projections of the sun's places, in these circles, at the times of observation, be now found, a circle traced through them will evidently be the projection of the circle of declination, which the sun describes in the heavens that day; and the position of the meridian may now be found, because it will pass through the centre of that circle, and O, the centre of the horizon. Hence we derive the following construction.

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Make three right angled triangles AOV, A′OV, A″OV, (Fig. 5.) which have each VO=VO, in Fig. 4. the height of the style; and bisect the angles at V, by the lines V*a*, V*a*′, V*a*″. Produce the shadows AO, AO′, AO″, so that O*a*, O*a*′, O*a*″ of Fig. 5. may be respectively equal to O*a*, O*a*′, O*a*″ of Fig. 4. Describe a circle through the points *a*, *a*′, *a*″, and from X its centre, draw a line through O; this will be in the direction of the meridian. For by the principles of the stereographic projection of the sphere, if we take the horizontal plane A, A′, A″, for the plane of projection; the lines O*a*, O*a*′, O*a*″, will be the projections of circles passing through the zenith and the sun, at the times when the shadows have the positions OA, OA′, OA″; and as by construction, O*a*, O*a*′, O*a*″ are the tangents of half the zenith distances AVO, A′VO, A″VO, the points *a*, *a*′, *a*″, are the projected places of the sun; and the circle *a*, *a*′, *a*″, is the projection of the parallel it describes in the heavens on the day of observation, and OX, which passes through its centre, is the projection of the meridian. See Projection of the Sphere.

Plate CCXXVIII. Fig. 5.

30. We may even find the latitude of the place of observation: For if P, the projection of the pole of the circle, be found, then OP will be the tangent of half the distance of the pole from the zenith, (OV being taken as radius,) that is, the tangent of half the complement of the latitude.

30. In this construction, no allowance is made for refraction, or change of declination. The zenith distances may, however, be corrected for refraction by the proper tables: (See Astronomy, pages 660 and 799.) And if the observation be made on the solstitial days, the error from change of declination will hardly be any thing. This method of tracing a meridian line was proposed by a very old author on dialling, named *Mutio Oddi da Urbino*, in a work called *Gli Horologi Solari Nelle Superficie piane*.

31. Another method of tracing a meridian line is, by observing when two stars which have the same right ascension, or whose right ascensions differ by 180°, come into the same vertical plane; for then they are both on the meridian. The observation may be made by means of a plane surface, kept in a vertical position by its own weight, or by any other suitable contrivance, and which is moveable about a vertical line. The pole star and the first ε of the tail of the *Great Bear*, are applicable to this purpose. In the beginning of 1811, their mean right ascensions were,

Star ε, ...	191°	25′	3″
Pole Star, ...	13	41	41
	177	43	22

This difference, although not exactly 180°, is yet sufficiently near; because when ε is on the meridian, the arc of 2° 16′ 38″, by which the pole star has advanced in the small circle it describes, subtends an angle of about 4′ only. The stars α of *Ophiuchus*, and β of the *Dragon*, are well adapted to the same purpose, the right ascensions and declinations are,

	R. Ascen.	Declin.
α of Ophiuchus, . .	261° 32′ 26″	12° 42′ 29N″.
β of Dragon, . . .	261 32 33	52 26 47N.

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As these have almost the same right ascension, and differ 40° in their declination, they are very proper for determining the position of the meridian.

32. In whatever way a meridian is traced on the horizontal plane, it should be quite adjoining to the plane on which the dial is to be delineated; and it ought to be so placed, that a vertical plane passing along the meridian line, may cut the dial at the point where the axis is to be fixed. To take a familiar example, we shall suppose that the dial plane is a vertical wall carefully smoothed and verified with a rule and plumb-line; and this being understood, it will be easy to suit the operation to any other plane.

Plate CCXXVIII. Fig. 6.

Let BC (Fig. 6.) be the meridian line on a horizontal table, and *tn*, *sq*, two plumb-lines, which descend on the meridian line from a horizontal rod that has one end fixed in the wall, and the other supported on a stand. If the table admits of being pierced with two holes, the plumb-lines may with advantage pass through them, and the plummets hang suspended in vessels filled with water. They will thus be more steady, and more easily adjusted. The eye is now to be directed towards the wall, so that the visual ray may be in the plane of the plumb-lines; and then the line AK upon the wall, which they both appear to cover at once, will manifestly be the intersection of the plane of the meridian, and the plane of the dial; and consequently will be the twelve o'clock hour line. A point A is now to be assumed, as the centre of the dial; and the axis AC must be fixed in the wall in such a position, that it may lie in the plane of the threads *tn*, *sq*, and make with a horizontal line AD, an angle equal to the latitude of the place, or with CR, a vertical line, an angle equal to the co-latitude; and then it will manifestly be parallel to the axis of the world.

33. The stile may have any shape that admits of its being firmly fastened to the dial; and before it is fixed, it may be convenient to fasten a piece of wood to the wall, so that it may have a plane surface exactly in the plane of the meridian, as indicated by the plumb-lines, and a line traced on its surface in the position of the axis or edge of the stile; this board will serve to support the stile in its position, until it be fastened either with its plane in the plane of the meridian, or perpendicular to the plane of the dial; but it will look most symmetrical in this last position. In whatever way it is fixed, the edge which projects the shadow must be in the plane of the meridian, and parallel to the earth's axis.

34. When the position of the plane of a dial in respect of the earth's axis is known, the determination of the hour lines is a geometrical problem by no means difficult. As at every hour the sun is in one or other of twelve great circles of the sphere, which intersect at the poles of the heavens, and which make equal angles with one another, the general problem to be resolved is evidently this: *Let there be twelve planes, which intersect in a straight line, and make equal angles with one another; and let these planes, indefinitely produced, meet another plane in any position whatever, to determine the lines in which they cut that plane.*

In resolving this problem, it will be convenient to begin with the more simple cases, and to reduce the others as much as possible to them.

Equinoctial Dial.

Equinoctial dial.

35. This dial, seen obliquely in its proper position, is represented by the upper part of Fig. 3. Its plane is parallel to the equator, and is the same as the plane of the equinoctial circle in the heavens; E is its centre, and EF its axis. As the hour circles in the heavens are perpendicular to the equinoctial circle, and divide it into 24 equal parts, the lines in which the plane of the dial cuts their planes, that is, the hour lines, will make 24 equal angles round the centre of the dial.

Plate CCXXVIII. Fig. 3.

It appears, then, that to delineate a dial of this kind, nothing more is necessary than to describe a circle on its plane, and to divide its circumference into 24 equal parts; and having drawn lines from the centre to the points of division, these will be the hour lines against which the characters denoting the hours are to be written; if the axis be now fixed perpendicular to the plane, the dial will be constructed.

In fixing this dial, the axis EF must be in the plane of the meridian, and must make with the horizontal meridian line, an angle equal to the latitude of the place, and then it will point to the pole of the heavens as it ought.

36. As the sun is one half of the year on the north side of the equinoctial, and the other half on the south side, it will be proper to trace hour lines on both faces of the dial; and in north latitudes the hours will be shewn on the upper face of the dial in summer, and on the lower face in winter; but on the equinoctial days, neither face will be illuminated.

The rays of the sun will always fall very obliquely on this dial in our latitudes, but to remedy this, a rim may be put round it, rising a little above the planes of its faces. The inside of the elevated part of the rim will be strongly illuminated by the sun's rays, and thus the hours will be more distinctly shewn.

37. A dial of this construction, which admits of being adjusted to any latitude, is delineated at Fig. 7. In this instrument, ABCD, and CDEF are two quadrangular pieces, (which may be of ivory, wood, or metal,) connected by means of a hinge at C, D. An equinoctial dial is described on each side of ABCD, or on one of them, and in the centre I, a style is placed at right angles to the planes of the dials. At G, in the middle of the piece EDCF, a magnetic needle is suspended, and covered with a plate of glass. At L, there is a quadrant fixed perpendicular to the plane of this piece, and divided into degrees. It passes through H, an aperture made to receive it in the upper piece. Fig. 7.

When the dial is to be used, it must be placed on a horizontal plane, so that the needle may be in the magnetic meridian. The upper piece must now be turned round the hinge, so that the planes of the two pieces may make with each other an angle equal to the latitude, as measured by the graduated quadrant. The hour of the day will then be shewn by the axis I, on one or other of the two, faces except on the day of the equinox.

Horizontal Dial.

38. A dial traced on a horizontal plane, is called a *Horizontal dial.* This is the most common and most useful of any, because it admits of being always illuminated when the sun shines. A dial of this kind is represented in perspective in Fig. 8. The point C is the centre, and CK, which is directed to the pole of the heavens, and makes with the plane of the dial an angle equal to the latitude of the place, is the axis. Horizontal dial. Plate CCXXVIII. Fig. 8.

To understand its nature and construction, let ABD be an equinoctial dial, whose axis EF is the prolongation of the axis of the horizontal dial; and let the planes of the two dials meet in the line PQ, and suppose the plane of the meridian to cut the plane of the

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horizontal dial in CM, and that of the equinoctial dial in EM; then the line PQ being the common intersection of the equinoctial and horizontal planes, which are perpendicular to the meridian, that line itself is perpendicular to the meridian. See GEOMETRY.

Let a plane passing through the sun's centre and the common axis of the dials, meet their planes in the lines EH, CH, these lines will manifestly be the positions of the shadows on the two dials at the same instant of time.

39. Now, at any given time, we know the angle HEM which the revolving shadow EH makes with the meridian line EM on the equinoctial dial, because it is the *horary angle* which the sun has to describe, or has described about the earth's axis, between the given time and noon, and which is always proportional to that time, reckoning 15 degrees of the angle to an hour. And in the triangle CEM, right angled at E, we know the angle ECM, which is always equal to the latitude of the place for which the dial is to be constructed; and from these we must find the angle HCM, which the hour line HC, on the horizontal dial, makes with CM, the meridian, or 12 o'clock line.

Let us denote the horary angle HEM, which the sun describes between the given time and noon, by the letter E, and the angle HCM, which the hour line on the horizontal dial makes with the meridian, by C, and let the angle ECM, the latitude of the place, be L; then, by plane trigonometry, in the two right angled triangles, EMH, CMH,

$$\text{HM} : \text{ME} :: \text{tan. E} : \text{rad.}$$

$$\text{and CH} : \text{HM} :: \text{rad.} : \text{tan. C};$$

therefore, *ex æquo inv.* (see GEOMETRY,)

$$\text{CM} : \text{ME} :: \text{tan. E} : \text{tan. C},$$

$$\text{but CM} : \text{ME} :: \text{rad.} : \text{sin. L};$$

$$\text{therefore, rad} : \text{sin.L} :: \text{tan. E} : \text{tan. C.}$$

Now, the first three terms of this proportion are known, therefore the last is also known; and we get this general formula for constructing a horizontal dial.

$$\text{tan. C} = \text{sin. L. tan. E.} \quad . \quad . \quad . \quad . \quad (1)$$

in which radius is supposed $=1$. The logarithmic formula, deduced from it, may be expressed in words at length, thus:

To the logarithmic tangent of the horary angle described by the sun between noon and the given time, add the log. sine of the latitude, and the sum, abating 10, *(the log. of rad.) is the logarithmic tangent of the angle which the hour line on the dial makes with the meridian line.*

40. EXAMPLE. Let it be required to calculate the angles which the hour lines on a horizontal dial, for Edinburgh, make with the meridian or 12 o'clock line: The latitude of Edinburgh being about 56°, a calculation for the hour lines of XI in the forenoon and I in the afternoon would be as follows:

log. tan. horary angle 15°	9.42805
log. sin. lat. 56°	9.91857
log. tan. 12° 32′	9.34662

Hence it appears, that the hour lines for XI in the forenoon, and I in the afternoon, must each make with the meridian an angle of 12° 32′.

The angles which the remaining hour lines make with the meridian may be found in the same way, and will be as follows:

Hour lines of X and II	25°	35′
IX and III	39	40
VIII and IV	55	8
VII and V	72	5
VI and VI	90	0

The hour lines of V in the morning, and VII in the evening, make the same angles with the meridian as the hour lines of VII in the morning and V in the afternoon; but they lie on opposite sides of the VI o'clock hour lines. In like manner, the hour lines of IV in the morning, and VIII in the evening, make the same angles with the meridian as the hour lines of VIII in the morning and IV in the afternoon, and so on.

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The construction of the dial is now very easy, as it requires nothing more than to make an angle of a given number of degrees. Thus, draw the meridian line CM (Fig. 9.) and cross it at right angles by the six o'clock hour line CG; and as the style of the dial must have some thickness, it will be proper to draw two parallel lines CM, C′M′ for the meridian line, so that the distance between them may be equal to that thickness.

PLATE CCXXVIII. Fig. 9.

From the points C, C′, draw the lines CI, C′XI on opposite sides of the meridian, so that the angles MCI, M′C′XI may be each 12° 32′; and these lines will be the hour lines of I in the afternoon, and XI in the forenoon; the former lying on the east and the latter on the west side of the meridian, when the dial is placed in its proper position. In the same way, all the other hour lines may be laid down on the plane of the dial, using a scale of chords, or a protractor, such as is commonly sold by mathematical instrument makers. Or a quadrant of a circle $p\,q$ may be described on C as a centre, and divided into 90 equal parts, and the hour lines drawn at once through the points of the arc indicating the number of degrees and minutes they ought to make with the meridian. The stile KCL (Fig. 8.) must be so constructed that the angle contained by CK and CL, the edges of one of its planes, may be 56°, the latitude of the place, and it may be fixed into the plane of the dial by two tenons at C and L let into openings made to receive them. The edge CK must stand directly over the meridian line CM, and then the afternoon hours will be shewn by the limit of the shadow of the triangular plane KCL.

The stile may have any shape, provided its edge CK be a straight line. It may even be a cylindrical rod, but in that case the hour lines ought to be tangents to its section with the plane of the dial. The angles they make with the meridian will, however, be the same.

41. Instead of an axis directed to the pole, we may substitute a vertical pin; for if, from any point K in the axis, a perpendicular KL be let fall on the meridian line, and the axis be removed, leaving the vertical line KL, it is evident that the shadow of its top K will come to any hour line at the same instant that the edge of the shadow of the axis CK would have fallen on that line.

To form this stile, we must, at any point L in the meridian, erect a vertical pin of such a height, that a line drawn from its top to the centre of the dial, may make with the meridian an angle equal to the latitude. In this case the meridian may be a single line if the stile have a sharp point, and then the extremity of the shadow will point out the hour of the day. This kind of stile, however, cannot indicate the hour for some time after sun-rise and before sun-set, because of the shadow extending beyond the limits of the dial.

The hours may also be indicated by the shadow of any point whatever, provided a line drawn from it to the centre of the dial pass through the pole of the world. Hence the stile may be any ornamental or emblematical figure: for example, Time and the hour may be shewn by the shadow of the point of his scythe, &c.

42. We shall here give a Table, calculated by the for-

mula of art. 39. by which a horizontal dial may be constructed for any place in Great Britain.

A Table of the Angles which the Hour-lines form with the Meridian on a Horizontal Dial for every half Degree of Latitude, from 50° to 59° 30′.

Latitude.	A. M. I. XI.	A. M. II. X.	A. M. III. IX.	A. M. IV. VIII.	A. M. V. VII.	A. M VI. VI.
50° ′	11°38′	23°51′	37°27′	53° 0′	70°43′	90° 0′
50 30	11 41	24 1	37 40	53 11	70 51	90 0
51	11 46	24 10	37 51	53 24	70 58	90 0
51 30	11 51	24 19	38 4	53 36	71 6	90 0
52	11 55	24 27	38 14	53 46	71 13	90 0
52 30	12 0	24 36	38 25	53 58	71 20	90 0
53	12 5	24 45	38 37	54 8	71 27	90 0
53 30	12 9	24 54	38 48	54 19	71 34	90 0
54	12 14	25 2	38 58	54 29	71 40	90 0
54 30	12 18	25 10	39 8	54 39	71 47	90 0
55	12 23	25 19	39 19	54 49	71 53	90 0
55 30	12 28	25 27	39 29	54 59	71 59	90 0
56	12 32	25 35	39 40	55 8	72 5	90 0
56 30	12 36	25 45	39 50	55 18	72 12	90 0
57	12 40	25 51	39 59	55 27	72 17	90 0
57 30	12 44	25 58	40 9	55 37	72 22	90 0
58	12 48	26 5	40 18	55 45	72 27	90 0
58 30	12 52	26 13	40 27	55 54	72 33	90 0
59	12 56	26 20	40 36	56 2	72 39	90 0
59 30	13 0	26 27	40 45	56 10	72 44	90 0

In this Table, the angles formed by the lines for V in the morning and VII in the evening, IV in the morning and VIII in the evening, &c. are not marked, because, it has been already observed, they are the same as those for VII in the morning and V in the evening, VIII in the morning and IV in the evening, only they lie on opposite sides of the VI o'clock hour lines.

Use of the Table.

The use of the Table may be easily comprehended: If the place for which a horizontal dial is to be made, corresponds with any latitude in the Table, the angles which the hour lines make with the meridian may be seen at once. For example, it appears that the hour lines of XI and I must, in the latitude of 56°, make angles of 12° 32′ with the meridian. If the latitude be not contained in the Table, proportional parts may be taken without any sensible error. Thus, if the latitude be 54°15′, and the angles made by the hour lines of XI or I be required; as it appears from the Table that the increase of 30′ in the latitude, viz. from 54° to 54° 30′, corresponds to an increase of 4′ in the hour angle at the centre of the dial, we may infer, that an increase of 15′ will require an increase of 2′ nearly; and therefore that the angle required will be 12° 16′.

Geometrical Construction of Horizontal Dials.

Geometrical construction of horizontal dials.

43. As every geometrical problem admits of various constructions, so the hour lines on a horizontal dial may be determined in various ways, according to the view that is taken of the subject. They may all, however, be deduced from the formula investigated in art. 39, namely, that radius is to the sine of the latitude, as the tangent of the horary angle described by the sun between any hour and noon, is to the tangent of the angle which the hour line on the dial makes with the meridian. From this formula we immediately derive,

Method I.

Plate CCXXVIII. Fig. 10.

44. Let CMO, C′M′O′ (Fig. 10.) be the meridian line on the dial, the space between CM, C′M′ being left for the thickness of the style, and CC′ its centre, and 6 C 6 the six o'clock hour line.

Fig. 11.

1. Make a right angled triangle *c m o*, Fig. 11. of any magnitude, having one of its acute angles *c* equal to the latitude of the place.
2. In the meridian, take CM and C′M′ equal to *c m*, the hypothenuse of the triangle, and MO and M′O′ equal to *m o*, the side opposite to the angle *c*.
3. Through M, M′ draw PQ perpendicular to CO.
4. On O and O′, as centres with OM as a radius, describe quadrants MH, M′H′.
5. Divide each quadrantal arc into six equal parts.
6. Through the points of division draw the lines O 1, O 2, O 3, &c. also O′ 11, O′ 10, O′ 9, &c. meeting PQ in *v*, *u*, *x*, &c. and in *r*, *s*, *t*, &c.
7. From the points C, C′ draw lines C 1 *v*, C 2 *u*, C 3 *x*, &c. to the points *v*, *u*, *x*, &c. and C′ 11 *r*, C 10 *s*, C 9 *t*, &c. to the points *r*, *s*, *t*, &c. and these will be the hour lines of the dial, viz. C 1 and C 11 will be the hour lines of I in the afternoon and XI in the forenoon, and C 2, C 10 the hour lines of II and X, and so on.
8. The hour lines before six in the morning, and after six in the evening, are to be found from the adjoining intermediate hours, as directed in art. 40.

The demonstration of this construction is obvious; for in the right angled triangles OM *v*, CM *v*, we have

CM : M *v* : : rad. : tan. MC *v*,

and M *v* : MO : : tan. MO *v* : rad.

Therefore, *ex æquo inv.* CM : MO : : tan. MO *v* : tan. MC *v*, but CM : MO : : *c m* : *m o* : : rad. : sin. lat.; hence, rad. : sin. lat. : : tan. MO *v* : tan. MC *v*.

Therefore, the angle MC *v* is rightly determined, (art, 39.) and the demonstration applies alike to all the hour lines.

This construction, although very simple, is rather inconvenient in practice, because the lines O4, O5, and O8, O7, may go off the surface on which the dial is to be delineated, before they meet the line PQ. The next construction has not this defect.

Method II.

Fig. 12.

45. Let CM, C′M′ be the double meridian line (Fig. 12.), and 6C6 the six o'clock hour line, and let *c m o* (Fig. 11.), be a right angled triangle, constructed as directed in the first operation of Method I.

1. On C, C′ the centres of the dial, with a radius equal to *c m*, the hypothenuse of the triangle *c o m* (Fig. 11.) describe semicircles on opposite sides of the meridian.
2. On the same centres, with a radius equal to *o m*, (the side opposite to the angle which is the latitude) describe other two semicircles also on opposite sides of the meridian.
3. Divide each quadrant of the two semicircles into six equal parts, at the points of division 1, 2, 3, &c. 11, 10, 9, &c. and let the numbers be written at the points of division, in the same order, in respect to the meridian, as the characters for the hours are to be placed on the dial.
4. Then, to find the position of any hour line, as, for example, that for three in the afternoon: Let D be the third point of division on the inner circle, and E the third point of division on the outer circle, reckon-

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ed from the meridian on the quadrant through which the afternoon hour lines are to pass. Draw EBA perpendicular to the meridian, and DB parallel to it, meeting the perpendicular in B.

5. Draw a straight line from C through B, and the line CB will be the hour line for III in the afternoon, as required.

And in the very same way may all the other hour lines be drawn on the dial.

To prove the truth of this construction, let EB meet the meridian in A, and join EC, which will evidently pass through D. Because BD is parallel to AC, CE : CD : : AE : AB ; but by construction, CE : CD : : rad. : sin. lat. ; and, by trigonometry, AE : AB : : tan. ACE : tan. ACB ; therefore, rad. : sin. lat. : : tan. ACE : tan. ACB ; now ACE is equal to the horary angle which the sun describes in three hours ; therefore CB is the hour line for three in the afternoon. (art. 39.)

Construction of Dialling Scales.

Construction of dialling scales.

46. There is another very elegant geometrical construction for the hour lines, by which scales may be made for the construction of dials, which save the labour of dividing circles.

Plate CCXXVIII. Fig. 13.

To construct these scales, divide AB a quadrant of a circle, into six equal parts. Draw the line *b a* to touch the middle of the arc at G. Draw lines from the centre through A and B, the extremities of the arc, to meet the tangent in *a* and *b*, and also through the divisions, to meet the tangent in the points against which the numerals VI, V, IV, &c. are placed. Then the line between the extreme points *a* and *b* is the *scale of hours*.

Next, divide EF, a quadrant of the same circle, into 90 equal parts, (only every tenth division is marked in the Figure). From the points of division draw perpendiculars to OF, the radius. Draw lines through E and the bottoms of the perpendiculars, and produce them, until they meet the circumference again in the points 10, 20, 30, &c. Transfer the chords of the arcs D 10, D 20, D 30, &c. (also the chords of the intermediate arcs not distinguished in the Figure) to a straight line *d f*, numbering them as in the Figure ; and the line *d f* will be the *scale of latitudes*.

If the chords of all the arcs from 0° to 90° of the quadrant EF be transferred to another straight line *e f*, a *scale of chords* will be formed, which is frequently wanted in making dials.

Construction of a Horizontal Dial by the Scales.

Construction of a horizontal dial by the scales. Fig. 14.

47. Let CM, C′M′ be the meridian, and 6 C′C′ 6 the six o'clock hour line. (Fig. 14.)

1. From the scale of latitudes take the extent from the beginning of the scale to the division corresponding to the latitude of the place for which the dial is to be made, and set it off from C to *a*, and from C′ to *a*′.

2. From the points *a*, *a*′, place lines *a b*, *a*′ *b*′, each equal to the whole length of the scale of hours, to terminate at *b* and *b*′ in CM, C′M′, the meridian line.

3. Transfer the divisions of the scale of hours to the lines *a b*, *a*′ *b*′, numbering them as in the Figure.

4. From the points C, C′ draw the lines C 1, C 2, C 3, &c. also C′ 11, C′ 10, C′ 9, &c. and these will be the hour lines of the dial.

The morning hours before VI, and evening hours after VI, are found as explained in the other constructions. And the stile is to be formed in all respects as described in art. 40.

Plate CCXXVIII. Fig. 13, 14.

To demonstrate the truth of this construction, let the latitude for which the dial is made be equal to the number of degrees in the arc E *p*, (Fig. 13.) Then, *p q* being drawn perpendicular to OF, and E *q* drawn meeting the circle in *r*, and D *r* joined ; it is manifest from the construction of Fig. 13. and Fig. 14. that the triangle D *r* E (Fig. 13.) is in all respects equal to the triangle *a* C *b* (Fig. 14.) so that D *r*=C *a*, *r*E=C*b*, and DE=*a b* ; and since in Fig. 13. rad. : sin. lat. : : EO : O *q* : : E *r* : *r* D ; therefore, in Fig. 14. rad. : sin. lat. : : *b* C : C *a*.

Let H (Fig. 14.) be the point in which any one of the hour lines (for example that for IV in the afternoon) meets *a b*. In the six o'clock line, place CN equal to C *b* ; join *b* N, and through H draw KHL parallel to CN, meeting the meridian in K, and the line *b* N in L ; and join CL. And because N *b* and *a b* are similarly divided at L and H, and *a* H and H *b* in Fig. 14. are respectively equal to *a* IV and IV *b* in Fig. 13 ; therefore N *b* in Fig. 14. and *a b* in Fig. 13. are similarly divided at L and IV. Now the triangles NC *b* (Fig. 14.) and *a* O *b* (Fig. 13.) are manifestly similar ; therefore it is easy to see that the angle *b* CL in Fig. 14. must be equal to *b* OIV in Fig. 13 ; and hence *b*CL in Fig. 14. must be equal to the horary angle described by the sun between noon and IV in the afternoon.

Now LK=*b* K : HK : : tan. LC *b* : tan. HC *b*. But *b* K : HK : : *b* C : C *a* : : rad. : sin. lat. ; therefore rad. : sin. lat. : : tan. *hor. ang.* : tan. HC *b*. Hence it follows, (art. 39.) that the angle which the hour line HC, or IVC, makes with the meridian, is of the proper magnitude : and the same may be proved in like manner of all the others.

Construction of Horizontal Dials by a Globe.

Construction of horizontal dials by a globe. Fig. 15.

48. The construction of a horizontal dial, and indeed of any dial whatever, as will appear farther on, may be very naturally deduced from the doctrine of the sphere. For, let *a* P B *p* (Fig. 15.) represent the earth, which we may suppose transparent, and let its equator be divided into 24 equal parts by meridian circles *a*, *b*, *c*, *d*, *e*, &c. one of which is the geographical meridian of any given place, as Edinburgh, which we may suppose at the point *a*. If now the hour of 12 were marked at the equator, both upon that meridian and the opposite one, and all the rest of the hours in order on the other meridians, they will be the hour circles of Edinburgh, and the sun will move from one of them to another in an hour.

Now, if the sphere had an opaque axis, terminating at the points P *p*, the shadow of the axis, which is in the same plane with the sun and each meridian successively, would fall upon every particular meridian, and hour, when the sun came to the opposite meridian, and would therefore shew the time at Edinburgh, and all other places on the same meridian. If the sphere were now cut through the middle, by a plane ABCD, in the rational horizon of Edinburgh, one half of the axis would be above the plane, and the other half below it ; and if straight lines were drawn from the centre of the plane to those points where its circumference is cut by the hour circles of the sphere, those lines would be the hour circles of an horizontal dial for Edinburgh ; for the shadow of the axis would fall upon each hour line

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of the dial when it fell on the like hour circle of the sphere.

49. It appears, then, that to construct a horizontal dial by the terrestrial globe, we must place the globe in such a position, that the arc of the brazen meridian between the pole and horizon may be equal to the latitude of the place, and that any one of the meridians on the globe may coincide with the brazen meridian; and then the arcs of the horizon between its north point and its intersections with the 24 meridians on the globe will be the measures of the angles which the hour lines on the dial must make with the meridian line.

50. From the same principles we may derive immediately the formula which was investigated at art. 39. For, let PHp be any hour circle which cuts the horizon in H, then in the right angled spherical triangle PBH, there are given PB, one of its sides adjacent to the right angle B, equal to the latitude, and the angle HPB at the pole, which is equal to the hour angle from noon, to find HB, the arc of the horizon between the meridian and hour circle, passing through the sun, which arc is the measure of the angle at the centre of the dial contained by the meridian and hour line corresponding to that hour circle.

By the principles of spherics, (see Spherical Trigonometry), in any right angled spherical triangle, radius is to the sine of either of the sides about the right angle, as the tangent of the adjacent angle to the tangent of the other side about the right angle; that is, in the present case, as radius to the sine of PB, the latitude; so is the tangent of HPB, the horary angle in the heavens, to the tangent of HEB, the angle made by the hour line and the meridian at the centre of the dial.

Vertical South or North Dials.

Vertical south or north dials. Plate CCXXVIII. Fig. 16, 17.

51. These dials are described upon vertical planes, facing directly to the south and north. They are represented in Fig. 16. and Fig. 17.

As the planes of these dials coincide with the *prime vertical*, that is, the great circle of the sphere which passes through the zenith and the east and west points of the horizon, their intersections with the meridian or the XII o'clock hour line, will be a vertical line. The theory of these dials might be investigated exactly in the same way as that of the horizontal dial, and particular rules formed for their construction; but this is not necessary; for the geometrical constructions which have been investigated for a horizontal dial, may be made to apply to all dials whatever, by considering, *that if a horizontal dial were transferred from the place for which it was made, to any other place on the earth's surface, and fixed there in a position parallel to its original position, that is, with its plane parallel to the horizon of the place for which it was made, and its axis, as before, pointing to the pole of the heavens; then, in its new position, it will indicate the hour of the day at its original position, precisely as it did before it was removed.* This proposition, although not exactly, is almost exactly true, because of the great distance of the sun from the earth in comparison to the distance of one place on the earth from another.

52. From the above principle we may infer, that any plane dial whatever, at a given place, will be a horizontal dial for some place or other of the earth; and, therefore, to construct a dial on a given plane, we have only to find what place of the earth has its horizon parallel to that plane, and then on the given plane to construct a horizontal dial for that place, and it will shew the hour of the day there. This, however, may not be the hour of the day at the place where the dial is intended to shew time, but then it will differ from the true hour there always by the same given quantity, namely, by the difference of the longitudes of the two places reckoned in hours and minutes of time. For example, if it should be found that a certain plane at London was parallel to the horizon of St Petersburg; then a horizontal dial constructed on the plane for the latter place, would show the hour at St Petersburg. But as the difference of longitude between London and St Petersburg is about 30 degrees, corresponding to two hours in time, the dial would indicate noon when it was only ten in the morning at London; and it would shew one o'clock when the true time at London was eleven, and so on. However, the dial would be adapted to London if we wrote the character for the hour ten on the St Petersburg meridian line, and that for eleven on the one o'clock hour line, and so with the other hours.

53. The zenith of any place being in a line passing through the plane perpendicular to its horizon, it is easy to see that two places on the earth's surface which have their horizons perpendicular to one another, must have their zeniths 90 degrees asunder. Hence it follows, that a vertical south or north dial at any place, would be a horizontal dial to a place 90° south or north from that place, and on the same meridian. A vertical south or north dial at Edinburgh, for instance, the latitude of which is 56°, would be a horizontal dial at a place on the same meridian, and in 34° of south latitude, and it would shew the same hour of the day at both places, because the time of noon happens at both at the same instant.

54. Hence, if we put E for the horary angle from noon, and C for the angle which the corresponding hour line makes with the meridian of a north or south dial, and L for the latitude of the place, we get immediately, from the formula of art. 39,

$$\text{Tan. } C = \text{Cos. } L \text{ tan. } E \quad \ldots\ldots\ldots \quad (2)$$

a general formula for constructing a north or south dial; and by this, the angles which the hour lines make with the meridian may be computed. The other three methods of constructing a horizontal dial, (art. 44—48), apply equally to vertical south or north dials, only substituting the complement of the latitude, or what it wants of 90° for the latitude, observing that the axis must make with the plane of the dial an angle equal to the complement of the latitude, and must be in the meridian, and then it will point to the pole of the world, as must be the case in all dials.

55. In north latitudes, a north dial is only illuminated when the sun is on the north side of the equator; and the nearest times of the day to noon that can be shewn by it, are those at which the sun passes the prime vertical on the day of the summer solstice. A south dial can never be illuminated before six in the morning, nor after six in the evening; because, when the sun rises earlier, and sets later, he does not pass the prime vertical so early as six in the morning, and he crosses it again before six in the evening. It will be unnecessary, therefore, to describe upon either more hour lines than can be wanted.

Vertical East and West Dials.

56. These dials are traced upon vertical planes, fa-

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cing directly east and west; their planes, therefore, coincide with the plane of the meridian, and pass through the poles of the world.

Vertical east and west dials. Plate CCXXVIII. Fig. 18.

To explain the nature of these dials, let us suppose that NS, Fig. 18. is a straight line traced upon their planes in the direction of the earth's axis, and that it is crossed at right angles by a straight line EQ, which will be the intersection of the planes of the equinoctial and the meridian. Let us also suppose, that AB is a thin cylindrical rod, held directly over the line $a\,b$, and parallel to it, by two supports A a, B b; and that this rod passes through C the centre of a circle, which lies in the plane of the equinoctial circle, and which touches the plane of the meridian in c, the bottom of a perpendicular C c: this circle will evidently be an equinoctial dial, of which AB is the axis.

Let CK be the shadow which the axis projects on the plane of the circle, and let it be produced to meet the vertical plane in k; then a line drawn through k, perpendicular to EQ, will evidently be the direction of the shadow which the rod AB projects on the vertical plane, at the same instant of time that it projects on the equinoctial dial the shadow CK; and as the hours are indicated on the equinoctial dial by the position of the revolving shadow CK, they will also be shewn on the vertical plane EQNS, by the successive positions of the rectilineal shadow F k F, which will always be parallel to NS.

Now, as the plane a AB b is perpendicular to the plane of the meridian, and passes through the poles, it must be the plane of the six o'clock hour circle, or that circle in the heavens, passing through the poles of the world, in which the sun is always seen at six in the morning and six in the evening. Therefore the arc c K of the equinoctial dial, intercepted between the perpendicular C c and C k, the position of the shadow at any time will be the measure of the horary angle described by the sun in the heavens, between six o'clock and that time; and the straight line $c\,k$, the distance of the shadow of the rod AB from the line $a\,b$ immediately under it, will be the tangent of that arc to the radius C c.

57. Let the horary angle from six o'clock be denoted by E′, and let ck, the distance of the hour line from $a\,b$, be x; also let C c, the height of the rod above the plane of the dial, be denoted by d, then because rad. : tan. E′ :: d : x, the general formula expressing the position of the hour lines on an east or west dial, in respect of the line $a\,b$, will be (supposing radius$=$1)

$$x=d \text{ tan. } E' \quad . \quad . \quad . \quad . \quad . \quad (3)$$

from which it appears, that, in these dials, the position of the hour lines in respect of each other is altogether independent of the latitude of the place. Indeed the same thing might have been inferred from what has been said in art. 51. and 52, for a vertical east or west dial for any place whatever would manifestly be an horizontal dial at the equator.

Geometrical construction of Vertical East and West Dials.

Geometrical construction of vertical east and west dials. Plate CCXXIX. Fig. 1, 2.

58. The geometrical construction of these dials will be as follows:

1. On the east or west vertical plane, draw the horizontal line HR, (Figs. 1. and 2.) and assume in it any point c for the bottom of the style, the upper extremity of which is to project a shadow on the hour lines.

2. Through the point c draw the line NS, so as to make with HR an angle N c R, equal to the latitude of the place. The angle NcR must be towards the right hand on an east dial, but towards the left in a west dial, and the line NS will point to the poles of the heavens.

3. Through c draw EcQ perpendicular to NS, and EcQ will be the equinoctial.

4. In c S take $c\,b$ equal to the intended height of the stile, and on b for a centre, with $b\,c$ as a radius, describe a semicircle.

5. Divide the semicircle into 12 equal parts.

6. From b draw lines through the points of division to meet the line EQ.

7. Through the points of intersection draw lines perpendicular to EQ, and these will be the hour lines on the dial against which the hours are to be written, as in the Figure.

8. At the points a, b, the style is to be erected (see Fig. 3.) so that its height A a may be equal to $b\,c$, which is also the distance between the hour lines of 6 and 9, and the dial is finished. Plate CCXXIX. Fig. 3.

The east dial will shew the morning hours until it be nearly noon, and the west dial will shew the afternoon hours; but neither can indicate the time of noon otherwise than by the sun being in the plane of the dial.

The truth of the construction follows too obviously from the formula, (art. 54.) to require any formal demonstration.

Polar Dial.

59. A polar dial is that which is traced on a plane perpendicular to the meridian, and passing through the poles; therefore, like east and west dials, the axis of the sphere lies in its plane; and to shew the hours, its stile must be formed like theirs, and fixed over the meridian line. Polar dial.

The construction of this dial, which is represented at Fig. 4. will differ in no respect from that for an east or west dial, except that in these, the line NS, which passes through the pole, makes with the horizontal line HR an angle equal to the latitude; but in the polar dial, the lines NS and HR are perpendicular to one another: for if an east or west dial were to be turned about the six o'clock hour line as an axis, so that the plane of the dial were perpendicular to its former position, it would then become a polar dial, and what was before the hour line for six would be in its new position the hour line for noon. Fig. 4.

This kind of dial may shew time from a little after six in the morning to a little before six in the evening, provided it be of sufficient extent to admit of the shadow meeting its plane. At the hours of six in the morning or evening, its plane passes through the sun, and therefore is not illuminated.

If E denote the horary angle from noon, and x and d represent the same things as in the formula for east and west dials, the formula for constructing the polar dial will be,

$$x=d \text{ tan } E. \quad . \quad . \quad . \quad . \quad (4)$$

Vertical Declining Dials.

60. Any dial described on a vertical plane that does not directly face one of the cardinal points, is called a *vertical declining dial;* and of these there may be four Vertical declining dials.

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Vertical declining dials.

kinds, viz. south-east, south-west, north-east, and north-west decliners.

The *declination* of any plane, whether vertical or inclined, is an arch of the horizon intercepted between the plane and the prime vertical; or it is the arch of the horizon intercepted between the meridian and a vertical plane, which is also perpendicular to the proposed plane.

The *meridian* of any dial plane is a plane that passes along the axis, or edge of the stile, and is perpendicular to the plane of the dial.

The *substile* of a dial is the common section of its plane, and the plane of its meridian. In horizontal, and in vertical south and north dials, the substile coincides with the twelve o'clock hour line; but in declining dials this is not the case.

The *difference of longitude* of a dial plane is the angle which the plane of its meridian makes with the meridian of the place.

Plate CCXXIX. Fig. 5.

61. Let PQ, Fig. 5, be a vertical plane, a wall for example, having any aspect; and let us suppose that upon its face that looks towards the south, an axis or stile OC, has been fixed at O, in a position parallel to the axis of the diurnal motion, by what has been taught in art. 32. and 33.

It appears, in the first place, that the vertical line OB drawn from the point in which the stile meets the wall, will be the 12 o'clock hour line; for it is common to all the vertical planes which pass through C, and consequently must be the intersection of the plane of the dial, and the meridian of the place.

From C, the extremity of the stile, draw CB perpendicular to C XII, thus forming the right angled triangle OBC, which will be entirely in the plane of the meridian; and therefore the prime vertical WOE is perpendicular to it. Let us suppose that at any hour, for example two in the afternoon, the horary plane, (or plane passing through the axis and the sun,) cuts the prime vertical WOE in the direction Oy, and the plane of the dial POQ in the direction OY; the first of these lines indicates the hour on the prime vertical; and the second shews it on the plane of the dial; but to trace the line OY, we must know the angle BOY, and the whole difficulty of constructing the dial lies in the determination of this angle.

62. Let us suppose a horizontal plane to pass along CB, and meet the horary plane COy in the line CYy; then it is manifest that BCY may be considered as the plane of a horizontal dial, of which C is the centre, CO the axis, CB the meridian line, and CY the hour line for two in the afternoon; therefore the angle BCY will be known by formula 1. (art. 39.) And because the horizontal lines BC, By, lie, the one in the meridian, and the other in the prime vertical, they contain a right angle; now the angle YBy is the declination of the plane, (art. 60.) therefore CBY is its complement, and is known, because we suppose the declination known; hence all the angles of the triangle BCY are known.

Let the latitude of the place for which the dial is to be constructed be expressed by L, and the angle yBY, or EOQ the declination of the plane by D; and, as in the formula of art. 39, let the angle C, made by the hour line of a horizontal dial for the latitude L and the meridian line BC be denoted by C, then, in the triangle BCY, we have the angle at C=C, the angle B=90°—D, and therefore the angle BYC=180—(90—D)—C=90—(C—D.)

In the right angled triangles, OBC, OBY, which have OB, one of the sides about the right angles, common to both, we have, by the principles of trigonometry,

BC : BY : : tan. BOC, or co-tan. OCB : tan. BOY.

But in the triangle BCY, we have also

BC : BY (: : sin. Y : sin. C) : : cos. (C—D) : sin. C.

Therefore,

Cos. (C—D) : sin. C : : co-tan. OCB : : tan. BOY.

Now, the three first terms of this proportion are given, because the angles C and D are given, and also the angle OCB, which is the latitude; therefore, the fourth term, or the tangent BOY is known, and hence the angle BOY itself is known.

63. From the foregoing investigation, and the formula of art. 39, we derive a formula for the construction of a vertical declining dial, which may be expressed thus:

Let L=the latitude of the place.

D=the declination of the dial, reckoned from the east towards the south.

E=the horary angle the sun has described since noon.

O=the angle BOY, which the shadow has described about the centre of the dial since noon.

C=the angle which the shadow has described about the centre of a horizontal dial for that place in the same time, and which is found by the formula,

Tan. C=sin. L tan. E. (art. 39.)

then we have

Cos. (C—D) : sin. C : : cot. L : tan. O.

and hence,

$$\text{Tan. O} = \frac{\text{cot. L sin. C}}{\text{cos. (C—D)}} \quad \ldots \quad (5.)$$

In the construction from which the preceding formula was derived, we considered the half of the plane of the dial, which passed between the meridian and the prime, vertical, and hence we found the angle CBY=90°—D; however, the formula is general for all horary angles, only, in conformity to the law of geometrical continuity, if we regard the values of C for the afternoon as positive, those for the forenoon must be considered as negative; and as, by the Arithmetic of Sines, we have —sin. (+C)=sin.(—C), and cos. (—C—D)=cos.(C+D), the formula for the forenoon hours is,

$$\text{Tan. O} = -\frac{\text{cot. L sin. C.}}{\text{cos. (C+D)}}$$

The negative sign shews that the angle O ought to be taken on the other side of the meridian.

64. The above formula, although very simple, and well adapted to calculation, has yet the inconvenience of requiring two operations for each hour line; viz. one to find C from E, the horary angle, and another to find O from C. It will, therefore, be proper to investigate a formula that shall give the value of O in terms of E at once.

For this purpose, in the denominator of the formula, instead of cos. (C—D), put its equal cos. C cos. D+sin. C sin. D, (Arithmetic of Sines, art. 7.) and after dividing the numerator and denominator by cos. C, let tan. C be put for $\frac{\text{sin. C}}{\text{cos. C}}$, and the result will be,

$$\text{Tan. O} = \frac{\text{co-tan. L. tan. C}}{\text{cos D+sin. D tan. C}}$$

Now, let sin. L tan. E be substituted for tan. C, (art. 39.) and again, $\frac{\text{sin. E}}{\text{cos. E}}$ for tan. E, and then after reducing, we find, Vertical declining dials.

$$\text{Tan. O} = \frac{\text{cot. L sin. L sin. E}}{\text{cos. E cos. D} + \text{sin. L sin. E sin. D}}$$

Let d be such an arc, that

$$\text{Tan. } d = \text{sin. L tan. D},$$

from which it follows, that $\text{cos. D} = \frac{\text{sin. L sin. D cos. } d}{\text{sin. } d}$.

This value of cos. D being substituted in the formula, it becomes

$$\text{Tan. O} = \frac{\text{cot. L. sin. } d}{\text{sin. D}} \times \frac{\text{sin. E}}{\text{cos. E cos. } d + \text{sin. E sin. } d}.$$

Now, the denominator of the fraction is evidently cos. (E—d), or cos. (d—E). Hence, we have the following very simple formula for the calculation of the angle which the shadow of the axis of a vertical declining dial describes in any time before or after noon.

Let L be the latitude of the place,
D the declination of the dial,
E the horary angle described by the sun, reckoning from noon,
O the angle described by the shadow.

Find an angle d, such that $\text{tan. } d = \frac{\text{sin. L tan. D}}{\text{rad.}}$;

Also a line which we shall call the tangent of an angle a, such that $\text{tan. } a = \frac{\text{co-tan. L sin. } d}{\text{sin. D.}}$

$$\text{Then, tan. O} = \frac{\text{tan. } a \text{ sin. E}}{\text{cos. (E}-d)} \quad \ldots . \ (6)$$

for the afternoon hours,

and $\text{tan. O} = \frac{\text{tan. } a \text{ sin. E}}{\text{cos. (E} + d)}$ for the forenoon hours.

In applying the formula, if the horary arch E be less than the angle d, we may take d—E instead of E —d, for cos. (E—d) and cos. (d—E) are expressed by the same quantity.

65. We shall now give examples of the application of the formula.

Vertical south dial declining westward.

EXAMPLE 1. Let it be required to find the angles which the hour lines make with the meridian in a vertical south dial, that declines to the west 36°, the latitude of the place being $54\frac{1}{2}$ degrees.

In this example, the dial has the same aspect as that from which the formula has been investigated; for the half of the plane on which the afternoon hours are drawn passes between the meridian and prime vertical, making with it an angle equal to 36°; hence we have,
L=54° 30′; D=36°.

Calculation of the angle d;

	Logarithms.
Tan. D	9.86126
Sin. L	9.91069
Tan. (d=30°36′)	9.77195

Calculation of the quantity, tan. a.

Co-tan. L	9.85327
Sin. d	9.70675
Sin. D Ar. Comp.	0.23078
Tan. a	9.79080

As it is only the logarithm of the quantity tan. a that we want, we have no occasion to seek for the angle itself.

Next, to find the angle made by an hour line, as, for example, I in the afternoon, we have E=15°, and d—E=15° 36′, and the calculation may stand thus,

	Logarithms.
Sin. E	9.41300
Tan. a	9.79080
Cos. (d—E) Ar. Comp.	0.01630
Tan. (O=9° 26′) . . .	9.22010

Hence it appears, that the hour line of I in the afternoon makes an angle with the meridian of 9° 26′.

For XI in the forenoon we have E=15°, and d+E =45° 36′.

Sin. E	9.41300
Tan. a	979080
Cos. (E+d) Ar. Comp.	0.15511
Tan. (O=12° 52′)	9.35891

The angles made by the remaining hour lines, may be found in the same manner; and these, as well as the *data* from which they are derived, are expressed in the following Table, which extends from IX in the morning to VIII in the evening, the time during which the dial is illuminated.

Given L=54° 30′, D=36 0; hence d=30° 36′, log. tan. a=9.79080.

Hours.	E.	E±d.	Angle O.
IX A. M.	45°	75° 36′	60° 21′
X	30	60 36	32 10
XI	15	45 36	12 52
XII	0	30 36	0 0
I P. M.	15	15 36	9 26
II	30	0 36	17 10
III	45	14 24	24 17
IV	60	29 24	31 34
V	75	44 24	39 52
VI	90	59 24	50 30
VII	105	74 24	65 44
VIII	120	89 24	88 52

This dial is represented in Fig. 6. And it is evident that if the hour lines be produced, and the axis continued on the other side of the plane, (considered as transparent,) we shall have a north dial declining to the east 36°.

PLATE CCXXIX. Fig. 6.

Vertical south dial declining eastward.

EXAMPLE 2. Suppose a vertical south dial to decline east 49°, in the latitude $51\frac{1}{2}$ degrees.

In this case, the plane of the dial passes between the north and east points; therefore, if we reckon the declination from the east towards the south, in the present case, D=360°—49°. Let D′=49°, then D=360 —D′; hence tan. D=—tan. D′; and since the sign of tan. d depends on that of tan. D, it follows that tan. d is negative, and d between 270° and 360°. Let d'=360 —d; then tan. d'=(— tan. d=—sin. L tan. D)=sin. L tan. D′, and cos. (d—E)=cos. $\{360° - (d' + \text{E})\}$ =cos.(d'+E); also cos.(d+E)=cos. $\{360 - (d' - \text{E})\}$ = cos. (d'—E). Hence, in this case, our formula, (art. 64.) becomes

$$\text{tan. O} = \frac{\text{tan. } a \text{ sin. E}}{\text{sin. } (d' + \text{E})} \text{ for the afternoon,}$$

$$\text{and tan. O} = \frac{\text{tan. } a \text{ sin. E}}{\text{sin. } (d' - \text{E})} \text{ for the forenoon.}$$

Vertical declining dials.

To find d'

Tan. D'	10.06084
Sin. L	9.89354
Tan. (d'=42°)	9.95438

To find tan. a,

Cot. L	9.90061
Sin. d'	9.82551
Sin. D' Ar. Comp.	0.12222
Tan. a	9.84834

From the angle d a series of angles $d+15°$, $d+30°$, &c. is to be formed for the afternoon hours, and another $d—15$, $d—30$, &c. for the forenoon hours, and from these the hour angles at the centre of the dial may be calculated exactly, as in the last example. The *data* and the results obtained are given in the following Table:

Given L=51° 30′, D′=49 0	hence d'=42°, log. tan. a=9.84834.		
Hours.	E.	$E \pm d'$.	Angle Ô.
III A. M.	135°	93°	95° 59′
IV	120	78	71 12
V	105	63	56 19
VI	90	48	46 30
VII	75	33	39 5
VIII	60	18	32 42
IX	45	3	26 32
X	30	12	19 49
XI	15	27	11 35
XII	0	42	0 0
I P.M.	15	57	18 32
II	30	72	48 47

PLATE CCXXIX. Fig. 7.

This dial is represented in Fig.7. If the hour lines were produced, and the axis continued through the plane, we would evidently have a north dial declining westward.

In general, to make a north declining dial, we have only to make a south declining dial, whose declination is the same, and lies the same way, and then turn it upside down, and it will be a north declining dial; but the hours must be numbered the contrary way; so that the two examples we have given will apply to all the varieties of declining dials.

66. The formula which has been investigated in article 64, gives the position of the hour lines immediately, when the latitude of the place and declination of the plane are known. But there is another method of constructing a declining dial, by considering it as a horizontal dial for some place of the earth, as explained in art. 52. and finding the latitude of that place, and the difference between its longitude and that of the place where the dial is to shew the hours. The first of these is equal to the angle which the axis of the dial makes with its plane, that is, the angle which the axis makes with the substile; and the second is the time which the shadow takes to pass from the XII o'clock hour line to the substile, from which the angles contained by these lines may be found. These three elements being known, viz. the latitude and longitude of the place where the dial would be horizontal, and the angle made by the twelve o'clock hour line and substile, the construction of the dial is reduced to that of a horizontal dial.

67. The elements for constructing the dial in this way, may be found by spherical trigonometry, as follows:

PLATE CCXXIX. Fig. 8.

Let SN z be the meridian, in which Z and z are the zenith and nadir, and P, p the poles. Let SEN be the horizon, S and N being the south and north points, and E the east. Let ZF z be any vertical plane, or great circle, on which the dial is to be drawn; let this plane meet the horizon in F, and the meridian in the vertical line ZO z, and let it be cut perpendicularly in A a by the plane of a great circle PA p passing through the poles. Then, from the construction of the figure, it appears that O p or OP is the axis of the dial, (according as it faces towards the south or north), O z or OZ the twelve o'clock hour line; and O a or OA the substile, (Art. 58.)

In the right angled spherical triangle ZAP, (of which A is the right angle) PZ is the latitude of the place where the dial is to indicate time; the angle AZP, which is measured by the arch of the horizon FN, is the complement of EF, the declination of the plane; and these are both given to find AP the measure of the angle contained by the axis OP and substile OA, also AZ the measure of the angle which the substile makes with the vertical or twelve o'clock hour line; and, lastly, the angle ZPA, which is the difference of longitude of the plane, (Art. 60.)

By the principles of spherics, (see TRIGONOMETRY, *Spherical*), in the triangle ZAP,

Rad.: sin. ZP : : sin. Z : sin. AP
Rad.: cos. Z : : tan. ZP : tan. AZ
Rad.: cos. ZP : : tan. Z : cot. P.

Hence, putting L for the latitude of the place where the dial is to be constructed, and D for the declination of the dial, we get

Rad.: cos. L . : cos. D : sin. lat. of dial,
Rad.: sin. D : : cot. L : tan. of angle made by Sub.&Ver.
Rad.: sin. L : : cot. D : cot. dif. of long. of dial.

Thus, it appears, that the dial would be horizontal at a place of which the sine of the latitude is cos. L cos. D, and the cotangent of its difference of longitude equal to sin. L cot. D; and, moreover, that the tangent of the angle contained by the meridian line traced on the dial for that place, and the vertical or twelve o'clock hour line, where it is to be fixed, is equal to Sin. D cot. L; and from these three *data* the dial may be constructed, either arithmetically or geometrically, by the formula of art. 39, or the rules of art. 43—47, for a horizontal dial. And the hour lines must be so calculated, that one of them, to be taken as the twelve o'clock hour line, may coincide with the vertical line. To do this, we must form a series of arcs, by the repeated addition of 15° to the difference of longitude, on the one hand, and by the repeated subtraction of 15° on the other, until at last there be a remainder less than 15°. Then we must take the difference of longitude and these arcs as the successive values of E in the formula of art. 39, and the corresponding values of C will be the angles which the hour lines on one side of the substile make with it, and the angle corresponding to the difference of longitude, will evidently be equal to the angle the vertical line makes with the substile. Again, by adding repeatedly 15 degrees to the difference between 15°, and the remainder left in forming the first series; this difference and the succeeding terms of the series being put

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for E, will give the angles the hour lines make with the substile on the other side. The reason of this is too evident to require particular explanation.

The ingenious diallist may verify the calculations of the angles in the two examples of our first method by this second method; and he will find, that in the first example, the angle made by the axis and substile is 28° 1′, the angle made by the substile and vertical is 22° 45′, and the difference of longitude 41° 45′.

In the second example, the axis makes with the substile an angle of 24° 6′, the substile with the vertical an angle of 30° 59′, and the difference of longitude is 55° 47′.

The dial of Ex. 1. would therefore be a horizontal one for the lat. 28° 1′, and that of Ex. 2. for the lat. 24° 6′.

To find the Declination of a Plane.

To find the declination of a plane.

Plate CCXXIX. Fig. 9.

68. We shall suppose that CO, the axis of the dial, (Fig. 9.) has been fixed, according to the method explained in art. 32. and that the meridian line O XII has been traced, as the foundation of all the other operations. From C, the extremity of the axis, let fall a perpendicular CB on the meridian line; and mark the point B where it meets the line; then through B trace a horizontal line *h* BH on the plane of the dial, and mark several points on it, such as H, *h*, equally distant from the point B. This done, measure very accurately all the sides of the triangles CBH, CB *h*; and in each calculate the angle at B. These angles ought to be the supplements of one another, and hence we may prove the accuracy of the observation. If they are both right angles, the plane is perpendicular to the meridian, and has no declination; but if they are unequal, the difference between each and a right angle is the declination of the plane.

The declination may also be easily found by placing a mark at a great distance in the plane of the dial, and then determining the position of this mark in respect of the meridian line traced on the horizontal plane; an operation which may be performed by any instrument for measuring angles. Or otherwise, the eye may be placed in the direction of the plane, so as to observe the instant when some one of the heavenly bodies passes the plane, and the hour of this observation being noted, the azimuth of the plane may be easily calculated.

Inclining Dials.

Inclining dials.

69. Inclining or oblique dials are traced on planes which stand at oblique angles to the horizon. They are either *reclining* or *proclining*. A reclining plane is one that leans backwards from an observer, and a proclining plane, which is also sometimes called an *inclining* plane, leans forwards.

The reclination and proclination of a plane is the angle it makes with a vertical plane, or it is the number of degrees that the plane leans from or to an observer, reckoned from the zenith. But *inclination* is properly the angle a plane makes with the horizon.

Fig. 10.

70. Whatever be the situation of a plane on which a dial is to be made, it is always possible to trace upon it a meridian line OB, in the direction of two plumb-lines, as explained in art. 32; and to fix at O, a point in that line, (Fig. 10.) an axis OC, pointing to the pole of the world. From C, the extremity of the axis, let a perpendicular BC be drawn to the meridian line, meeting it in B, and forming the right angled triangle COB. As the lines CB, BO, may be measured, the angle COB may be found.

Plate CCXXIX. Fig. 10.

Now, if we suppose the plane to be a vertical dial at some place of the earth, then OB will be a vertical line at that place, and the angle COB the complement of its latitude, which will therefore be known. If, in addition to this, we knew the declination of the plane, we might calculate the angles which the hour lines make with the meridian line, by the formula of art. 62. But it is easy to find the declination; for the horizon ought to be perpendicular to the vertical line OB. Now BC is also perpendicular to OB; therefore, if in *h*BH, a perpendicular to OB, we take BH=B*h*, and join CH, C*h*, the triangles CBH, CB*h*, will lie in the hypothetical horizon, and the inclination of the plane to the hypothetical meridian OBC may be determined, as shewn in art. 66.

71. If, besides the position of the meridian and the axis, we know the declination and reclination of a plane, then we may find the latitude of a place, where the plane would be a vertical declining dial, and also the declination of the dial at that place, and with these data find the angles which the hour lines make with the meridian by the formula for vertical dials, given in art. 62. Or else we may find the latitude and longitude of a place, where the plane would be a horizontal dial, and thence find the position of the substile, and construct the dial by the rules for a horizontal dial.

Fig. 11.

72. To begin with the first of these methods. Let SHN*h* be the meridian; (Fig. 11.) P*p* the axis of the sphere; Z the zenith of the place where a dial is to be made; SEN the horizon; S, E and N, the south, east and north points respectively. Also, let *h*FH be a plane or circle of the sphere on which the dial is to be made, and which meets the horizon in F, and intersects the plane of the meridian in the line H*h*; then PO*p* will be the axis of the dial, and HO*h* the meridian line. Moreover, the arch EF between the east point of the horizon and the plane will be its *declination*; and the spherical angle HFN its *inclination* to the horizon, or the complement of its *reclination* from the vertical position.

Let *s*E*n* be the horizon of the place which has H for its zenith, (and of course where the plane HF*h* would be a vertical declining dial,) and let it cut the plane in *f*. Because the two horizons SEN, *s*E*n* are perpendicular to the meridian, their intersection E will be the east point in both.

Let L=PN, the given latitude of the place where the dial is to be made.

D=FE, the given declination of the dial.

R=Comp. of angle *f*FE, its given reclination.

λ=P*n*, the latitude of the place where the dial would be vertical, which is to be found.

Δ=E*f*, its declination there, which is also to be found.

Then λ—L=N*n*=measure of angle FE*f*.

In the spherical triangle E*f*F, right angled at *f*, we have, by spherics,

Rad. : sin. EF :: sin. F : sin. E*f*,
Rad. : cos. EF :: tan. F : cot. E.

From these proportions, we get

$$\left.\begin{aligned}\text{Sin.}\,\Delta &= \frac{\text{cos. R sin. D}}{\text{rad.}}\\ \text{Cot.}(\lambda-\text{L}) &= \frac{\text{cot. R cos. D}}{\text{rad.}}\end{aligned}\right\}\ldots\ (7)$$

From these equations, we get the arcs λ and Δ, which

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being substituted instead of L and D in the formula art. 64, it will be a general expression for the angle O, which the shadow makes with the meridian line on the reclining dial.

Plate CCXXIX. Fig. 11.

73. Example.—Let it be required to find the hour lines on a south dial plane FHh, (Fig. 11.) that declines westward 25°, and reclines 15° in latitude $54\frac{1}{2}$.

In this example, D=25°, R=15°, L=54° 30′.

To find Δ.		To find λ.	
Rad. . . .	10.00000	Rad.	10.00000
Cos. R . . .	9.98494	Cot. R . . .	10.57195
Sin. D . . .	9.62595	Cos. D. . . .	9.95728
Sin.(Δ=29° 6′)	9.61089	Cot.(λ—L)=16° 27′	10.52923

Hence λ=(λ—L)+L=16° 27′+54° 30′=70° 57′.

As the dial declines to the west, we have (art. 64.)

$$\text{Tan. O}=\frac{\tan.\,a\ \sin.\,\text{E}}{\cos.\,(\text{E}-d)}\ \text{for the afternoon.}$$

$$\text{Tan. O}=\frac{\tan.\,a\ \sin.\,\text{E}}{\cos.\,(\text{E}+d)}\ \text{for the forenoon.}$$

$$\text{In these, tan. } d=\frac{\sin.\,\lambda\ \tan.\,\Delta}{\text{rad.}}$$

$$\text{Tan. } a=\frac{\cot.\,\lambda\ \sin.\,d}{\sin.\,\Delta}.$$

By proceeding as in the examples of art. 65, we shall find d, and log. tan. a.

The remainder of the calculation differs in no respect from that of the first example in that article. The Table exhibiting the values of the two series E and E∓d, and the angles O, which the hour lines make with the meridian line, will be as follows:

Given λ 70° 51′, Δ 24° 6′ hence d=22° 55′, log. tan. a=9.51759			
Hours.	E	(E∓d)	Angle O
VII. P. M.	105°	82° 5′	66° 34′
VI.	90	67 5	40 12
V.	75	52 5	27 21
IV.	60	37 5	19 39
III.	45	22 5	14 6
II.	30	7 5	9 25
I.	15	7 55	4 54
XII. noon.	0	0 0	0 0
XI. A. M.	15	37 55	6 10
X.	30	52 55	15 15
IX.	45	67 55	47 47
VIII.	60	82 55	66 36

Fig. 12.

The hour lines being drawn on the dial, so as to make with the XII. o'clock line the angles in this Table, the dial will be constructed. It is represented in Fig. 12.

74. To determine the position of the hour lines by the second method, or by finding the place of the earth where the dial would be horizontal, we must determine the position of the substile in respect of the meridian, and also find the latitude and longitude of the plane.

Fig. 11.

To do this, retaining the construction of Fig. 11, let a great circle PA, passing through the pole, and perpendicular to the plane of the dial, meet it in the line OA, which will be the substile; then the angle AOH is the angle which the substile makes with the meridian, or XII o'clock hour line, the angle AOP is the elevation of the axis above the plane of the dial, and the spherical angle APH is its difference of longitude.

In the spherical triangle AHP, right angled at A, the angle AHP being equal to fHs, is measured by the arc fs; but this arc is the complement of the arc fE, which we have (art. 72.) expressed by Δ; therefore the angle AHP is the complement of Δ. Again, the arc HP is the complement of the arc Pn, which we have expressed by λ. Now we have given formulas (art. 72.) for the computation of Δ and λ; therefore the angle AHP, and the side HP of the spherical triangle, may be considered as known.

The remaining three parts of the triangle may be found from the following analogies. (See *Spherical Trigonometry.*)

Rad. : cos. H :: tan. PH : tan. AH,
Rad. : sin. PH :: sin. H : sin. AP,
Rad. : cos. PH :: tan. H : cot. P.

By substituting Δ and λ in these proportions, we find

$$\left.\begin{array}{l}\text{Tan. AH (the angle made by}\\ \text{the substile and meridian)}\end{array}\right\}=\frac{\sin.\,\Delta\ \cot.\,\lambda}{\text{rad.}}$$

$$\left.\begin{array}{l}\text{Sin. AP (the angle made by}\\ \text{the axis and substile)}\end{array}\right\}=\frac{\cos.\,\Delta\ \cos.\,\lambda}{\text{rad.}}$$

$$\text{Cot. P (the diff. of long.)}=\frac{\text{Cot.}\,\Delta\ \sin.\,\lambda}{\text{rad.}}$$

If we apply these formulæ to the example of last article, we shall find

Angle made by sub. and merid.	8° 1′
Angle made by axis and substile,	17 20
Diff. of long. of dial plane,	25 20

The dial may now be constructed as a horizontal dial for lat. 17° 20′, and as the difference of longitude is 25° 20′, which corresponds to $1^{h}\ 41\frac{1}{3}^{m}$, and the meridian of the dial plane lies to the east of the XII o'clock hour line, we must find the hour lines of $2^{h}\ 41\frac{1}{3}^{m}$, $3^{h}\ 41\frac{1}{3}^{m}$, &c. reckoned from the substile of the dial, and consider them as the hour lines of XI, X, &c. in the forenoon; also we must find the hour lines of $41\frac{1}{3}^{m}$, and on the same side of the substile as the others, and consider it as the hour line of I. The hour line of II will lie on the other side of the substile, and will correspond to $18\frac{2}{3}^{m}$. The hour line of III will correspond to $1^{h}\ 18\frac{2}{3}^{m}$ from the substile, and so on. See Fig. 12. Plate CCXXIX. Fig. 12.

75. We have, for the sake of brevity, given no geometrical construction for declining or reclining dials, because in making a dial, every thing ought, as far as possible, to be determined by calculation, and scales ought to be employed no farther than in laying down the angles. However, if any one should wish for geometrical constructions, he may readily derive them from the formulas, (art. 64. and 72.) which are very simple.

Of the time at which the Sun begins or ceases to shine on a given Plane on a given Day.

Time at which the sun begins or ceases to shine on a given plane on a given day.

76. This is a problem of some importance in dialling, because by resolving it, we learn what hour lines we ought to trace on a dial. Our limits will not allow us to enter minutely into the various cases, but we shall briefly indicate how it is to be resolved in the general case, supposing a south reclining plane declining to the west. Retaining, therefore, the construction of Fig. 11, as described in art. 72, let PS be the hour circle passing through the sun, when he is in the plane of the dial on the afternoon of a given day. In the spherical triangle HAP, we have already found AP, the measure of the angle made by the axis and substile, and the angle HPA the difference of longitude Now, in the spherical triangle SAP, right angled at A, besides AP, we know SP, the distance of the sun from the pole on the given day. Hence the angle SPA may be found by this proportion, Fig. 11.

Tan. PS : tan. PA :: rad. : cos. APS.

The angle APS expressed in time, is half the period the

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sun shines on the plane, and the hour angle HPS, in time, is the interval between noon and the sun's leaving the plane. Taking the example of art. 73, it will be found that when the sun is in the northern tropic; and consequently PS=66° 30′, the angle SPA=82° 12′. Now we found, (art. 74.) that HPA=25° 20′; therefore, when the sun sets upon the plane, SPH, the horary angle from noon is 107° 32′=7h 10m, the sum of the two arcs; and when it rises, the horary angle is 56° 52′=3h 47m, their difference. Hence it appears, that it will be needless to trace upon the dial any hour line earlier than III in the morning, or later than VIII in the evening.

Of the Line described on a Plane by the extremity of a Shadow.

Of the line described on a plane by the extremity of a shadow.

77. Sometimes we see described on dials the path described by the extremity of the shadow of the axis, in the course of the day, at certain times of the year, and in particular at the times when the sun enters the different signs of the zodiac. As this is an interesting part of the theory, we shall investigate the nature of the path of the shadow, and shew how any number of points in it may be found.

PLATE CCXXIX. Fig. 13.

Let O, (Fig. 13.) be the centre of a horizontal dial; OA the meridian line; OF the axis; and OB the shadow of the axis at any time. From F, the top of the axis, draw FD perpendicular to OB, and DA perpendicular to OB, meeting the meridian in A, and join FB, FA. Because BD is perpendicular to the two lines DA, DF, it is perpendicular to the plane of the triangle FDA, (GEOMETRY,) therefore any plane passing along BD is perpendicular to the plane of the triangle FDA, and consequently the triangle FDA is perpendicular to the plane of the dial; but the triangle FAO is also perpendicular to the same plane; therefore CA, the common section of the two triangles, is perpendicular to the plane of the dial.

Let a=OF, the length of the axis;

r=OB, the length of its shadow;

C= {the angle BOA contained by the shadow and the meridian;

v= {the angle FOB, contained by the shadow and the axis;

L=the angle FOA, the latitude;

δ= {the angle OFB, the sun's distance from the pole.

Then, in the triangles FDO, ADO, both right angled at D, we have, by TRIGONOMETRY,

OD : OF : : cos. FOD : rad.;

OA : OD : : rad. : cos. AOD;

therefore, *ex æquali* OA : OF : : cos. FOD : cos. AOD; but in the triangle OAF, OA : OF : : cos. FOA : rad.

therefore cos. FOA : rad. : : cos. FOD : cos. AOD.

From the triangle OFB we get this other proportion,

Sin. (F+O) or sin. B : sin. F : : OF : OB.

By substituting for the lines and angles in these two last proportions their symbols, we have,

Cos. L : rad. : : cos. v : cos. C

Sin. $(\delta+v)$: sin. δ : : a : r

and hence,

$$\text{Cos. } v=\frac{\text{Cos. L. cos. C}}{\text{rad.}}, \quad r=\frac{a \sin. \delta}{\sin. (\delta+v)}$$

By these formulas, having given the sun's declination, we can readily find Or, the length of the shadow, for any value of C; or combining them with the formula, of art. 39, viz. tan. C=sin. L tan. E, where E is the horary angle from noon, we can find the length of the shadow at any time of the day.

78. These two formulas may be reduced to one, by elementing the angle v; for, supposing rad.=1, we have sin. $v=\sqrt{(1-\cos.^2 \text{L} \cos.^2 \text{C})}$; and by the arithmetic of sines, sin. $(\delta+v)$=sin. δ cos. v+cos. δ sin. v. By substituting for sin. v and cos. v their values, and putting sin. δ cotan. δ for cos. δ, we get from the second formula,

$$r=\frac{a}{\text{Cos. L cos. C}+\text{cot. }\delta\sqrt{(1-\cos.^2 \text{L} \cos.^2 \text{C.})}}$$

This formula exhibits the relation between the variable angle C, and the variable line r, the length of the shadow. By giving to C any number of successive values, and substituting the value of δ (taken from the tables of the sun's declination, p. 715.) for the given day, we may find any number of points in the path of the extremity of the shadow. It is not so convenient, however, for calculation, as the formula of last article.

79. It is easy to see that the path of the extremity of the shadow must be a conic section. For the straight line drawn from the sun through the top of the stile, which determines the length of the shadow, manifestly describes, by the diurnal motion of the sun, the surface of a cone, having the axis of the dial for its axis; and the path of the shadow is a section of this cone, made by the plane of the horizon. The polar equation of the path, found in last article, shews also that the curve is a conic section; for let it be put under this form,

$$a-r \cos. \text{L} \cos. \text{C}=\cot. \delta\sqrt{(r^2-r^2 \cos.^2 \text{L} \text{ Cos.}^2 \text{C})}.$$

Now, supposing x and y to be rectangular co-ordinates, which have their origin at O, we have r cos.C=x, and $r^2=x^2+y^2$; therefore, by substituting in the equation, and squaring, &c. we get

$$\left.\begin{array}{l}(\text{Cot.}^2 \delta \sin.^2 \text{L}-\cos.^2 \text{L})x^2+2a \cos. \text{L}x \\ \quad +\cot.^2\delta\, y^2-a^2\end{array}\right\}=0.$$

This expression may, by the arithmetic of sines, be transformed to

$$\left.\begin{array}{l}-\text{Sin.}(\delta+\text{L}) \sin. (\delta-\text{L})\, x^2+2a \cos. \text{L} \sin.^2 \delta\, x \\ \quad +\text{Cos.}^2 \delta\, y^2-a^2 \sin.^2 \delta\end{array}\right\}=0.$$

If L=δ, then sin. $(\delta-\text{L})=0$, and the equation belongs to a parabola.

If L is greater than δ, so that sin. $(\delta-\text{L})$ is negative, the equation belongs to an ellipse; but if L is less than δ, so that sin. $(\delta-\text{L})$ is positive, then the equation belongs to an hyperbola. In each case, the meridian line is the transverse axis of the curve.

If $\delta=90°$, so that cos. $\delta=0$, then the term containing y^2 vanishing, x has the same value for the whole day; which shews that the path is a straight line.

The path of the shadow is an ellipse at any place within the polar circle, on the days when the sun does not set. It is a parabola at that place on the day that the sun just touches the horizon at midnight. It is a straight line at all places of the earth on the equinoctial days. And in every other case it is a hyperbola.

80. The points in which the curve crosses its axis may be readily determined from its polar equation, (art. 78.) by making C=0, and C=180°. Thus, calling their distances from the centre of the dial r' and r'', we have

$$r'=\frac{a \sin. \delta}{\sin. (\delta+\text{L})}, \quad r''=\frac{a \sin. \delta}{\sin. (\delta-\text{L})}.$$

The first of these is the length of the shadow at noon. The vertices of the curve lie on the same side of the centre of the dial, when it is a hyperbola; but on opposite sides when it is an ellipse. The other elements of the curve may be discovered in like manner, and

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then it may be traced by the methods for describing a conic section. But perhaps in practice it may be sufficient to find the points in which the curve crosses the hour lines of the dial, and then to trace it nearly correct by some mechanical contrivance. The intersection of the curve and any hour line may be found by the following geometrical construction.

Plate CCXXIX. Fig. 14.

Let O be the centre of the dial, and O XII be the meridian line (Fig. 14.). Take any two lines OM, ON, having to each other the ratio of the cosine of the latitude to radius; and on O as a centre, with these lines as radii, describe circles. Take OF in the meridian line equal to the length of the axis of the dial, and at the point F make the angle OFH equal to the sun's distance from the pole. Let OY, any hour line, meet the lesser circle in K. Through K draw KL perpendicular to the meridian, meeting the greater circle in G. Draw OG, meeting FH in H. In the hour line OY, take OB equal to OH, and B is the point in which the hour line meets the path of the shadow.

For, by trigonometry, OG : OK :: sin. OKL : sin. OGL :: cos. KOL : cos. GOL; that is, (because the angle KOL or YOL$=$C) rad. : cos. L :: cos. C : cos. HOL; hence HOL is the angle we have denoted by v in the first of the two formulas, art. 77. Now the angle F$=\delta$, and OF$=a$; and sin. H : sin. F :: OF : OH; that is, sin. $(\delta+v)$: sin. δ :: a : OH, hence OH has the value of r in the second formula; and consequently OB$=$OH is the length of the shadow. Whatever has been said respecting the shadow on a horizontal dial will apply to any dial whatever, if L be put for the latitude of the place where the dial would be horizontal, and if we take the substile as the meridian.

Retrogradation of the Shadow.

Retrogradation of the shadow.

81. The shadow which is projected on a dial by the edge of a stile or axis directed to the pole, revolves about the centre always the same way. The hour may also be indicated by the shadow of a single point of the axis, which may be the summit of an upright wire, as explained in art. 41, and then the shadow will proceed, not from the centre, but from the bottom of the wire. The shadow on a horizontal dial for any latitude out of the torrid zone, with a stile of this construction, will also move always the same way; but at any place between the equator and tropics, there is a period of the year when the shadow moves forward, until it reaches a certain limit, and then it moves back again. This is what is called the *retrogradation* of the shadow.

Fig. 15.

To see how this may happen, let O (Fig. 15.) be the centre of a horizontal dial, and OF the axis; and let FA be a vertical rod, which meets the axis at F. The shadows of the material lines OF, AF, will form a triangle OfA on the surface of the dial, the vertex of which, f, will trace a curve $f\,f'\,f''\,f'''$, which in general will be an hyperbola. In the temperate zone, the point A always falls within the curve, but at any place between the equator and either tropic, when the sun passes between the zenith and the elevated pole, the point A falls without the hyperbola, so that straight lines Af', Af''' may be drawn from it to touch the curve. Now at the instant of sun-rise, the two shadows Of, Af will be parallel to one of the asymptotes; and as the day advances, their intersection f will move along the curve, arriving first at f', the point in which the tangent meets the curve, next at the vertex f'', and then proceeding along $f''\,f'''$, the other branch. Now by this motion of the point f, the shadow Af will turn about the point A in a direction from O to f'; but when it has arrived at the position Af', it will be for a moment stationary; as the intersection f advances to f'', the vertex, the shadow will evidently turn back; and when f arrives at f'', the shadow will coincide with the axis. A like phenomenon will be exhibited in the afternoon. The shadow will at first recede from the axis, until it coincide with the tangent Af'''; and then it will again approach the axis until it vanish at sun-set, and at that instant it will be parallel to the other asymptote.

All this may be observed on a dial in any latitude, provided its plane pass between the sun and the equator at noon, and the hour be shewn by a stile perpendicular to its plane.

The phenomenon we have been describing will appear very simple to the mathematician, and perhaps hardly worthy of particular notice; it seems, however, to have excited attention, probably because of the apparent solution it affords to the return of the shadow on the sun-dial of Ahaz. But this explanation is not admissible, because in that case, the return of the shadow must have been a thing altogether miraculous, otherwise it would not have excited attention.

Meridian of Mean Time.

Meridian of mean time.

82. The hour of the day indicated by a good sun-dial will agree with that shewn by a clock only on certain days of the year; in general, there will be a difference, which is called the *Equation of time.* The nature and quantity of this correction has been fully explained in ASTRONOMY, p. 652; and a Table given in page 797, by which it may be accurately found.

A line may be traced upon the plane of a dial, in such a manner, that the extremity of the shadow of the stile shall fall on it at the instant of *mean* noon, which will thereby be indicated just as the time of *apparent* noon is shewn by the shadow of the edge of the stile falling on the meridian line. The line which shews the time of mean noon is called the *meridian of mean time.* Its figure and position on a horizontal dial is shewn in Plate CCXXVIII. Fig. 9.

Plate CCXXVIII. Fig. 9.

To trace the meridian of mean time, the hour lines for 16 minutes before, and the same period after noon, should be found, and lines drawn from the centre to divide the angles which they make with the meridian into as many equal parts as may be thought necessary; for example, 96 lines may be drawn, and these will correspond, with sufficient accuracy, to portions of time, differing by 10 seconds one from another. But in some declining dials, the angular motion of the shadow at noon may deviate considerably from uniformity, and then it may be necessary to find the correct position of the hour lines for every fifth minute between apparent and mean noon.

The path of the shadow is next to be traced for as many different days of the year, equally distant, as may be thought necessary; and the point in which the path of the shadow cuts the hour line corresponding to the equation of time of any day will be a point in the meridian of mean time for that day. In this manner may any number of points be found, and a line traced through them; and the days of the year being marked opposite to them, the meridian of mean time will be finished.

The first who has spoken of a meridian of mean time was M. De Fouchy, of the Academy of Sciences, before the year 1740. The republic of Geneva had one traced in 1780; and the instant of mean noon was made known by a signal from the church of St Peter, to enable the watch-makers to regulate their instruments to mean time.

Dials with variable centres.

Dials with Variable Centres.

83. Dials of this kind, although not common, nor very convenient, are yet curious, and deserve to be known, on account of the elegance of their mathematical theory. This may be deduced from the following proposition, which seems to be one of the class called by Geometers, *Porisms.*

A system of hour points may be found on a plane, such, that for every day in the year (or any time in which the sun's declination may be regarded as constant) there is a point in the meridian line at which, if a stile be placed in the plane of the meridian, so as to make with the horizon any given angle, its shadow shall pass through the different hour points at the instants of time corresponding to them, and in this way shew the time of the day.

In order to investigate the truth of this proposition, we shall resolve the following problem.

Problem. Having given the sun's declination, and the time from noon, and also the latitude of a place, to find the angle which the shadow of a stile makes with the meridian line on a horizontal plane, supposing the stile to lie in the plane of the meridian, and to make with the horizon a given angle.

Plate CCXXIX. Fig. 16.

Let LMN be the horizon, LPN the meridian, P the pole, CQ the stile, which meets the meridian in the heavens at Q; let S be the sun in the hour circle PS, and MSQX a great circle passing through S and Q, and cutting the plane of the horizon in the line MCX.

Put λ for PN, the given latitude;

ε for QN, the given elevation of the stile;

δ for the comp. of PS, the sun's given dec.

ϕ for QPS, the given hour angle;

ψ for the angle LQM;

θ for the angle XCN or arc LM, which is to be found.

By *Spherical* Trigonometry, if a and b be the sides of a spherical triangle, C the angle they contain, and A the angle opposite to a, then

$$\text{Cot. A sin. C}+\text{cos. C cos. } b=\text{cot. } a \text{ sin. } b.$$

Also in a right angled spherical triangle, if a and b be the sides about the right angle, and A the angle opposite to a,

$$\text{Cot. } a \text{ sin. } b=\text{cot. A}.$$

In the first of these two formulas, let $PS=90-\delta$, and $PQ=\varepsilon-\lambda$ be put for a and b; also $P=\phi$ for C, and $SQP=180^o-\psi$ for A, and we get

$$-\text{cot. }\psi \text{ sin. }\phi+\text{cos. }(\varepsilon-\lambda)\text{ cos. }\phi=\text{sin. }(\varepsilon-\lambda)\text{ tan. }\delta;$$

and in the second let sin. QL=sin. ε be put for sin. b, and $LM=\theta$ for a, also $LQM=\psi$ for A, and the result will be

$$\text{Cot. }\theta\text{ sin. }\varepsilon=\text{cot. }\psi.$$

Let this value of cot. ψ be substituted instead of it in the preceding equation, and we shall get, by transposition and division,

$$\text{Cot. }\theta=\frac{\text{Cos. }(\varepsilon-\lambda)\text{ cos. }\phi-\text{sin. }(\varepsilon-\lambda)\text{ tan. }\delta}{\text{sin. }\varepsilon\text{ sin. }\phi}.$$

From this formula, we may find the value of θ, the angle made by the shadow and the meridian, as required.

Fig. 17.

84. Let us now suppose that Fig. 17 represents any dial with a moveable centre, O XII being the meridian line; XI, X, &c. the forenoon hour points; and I, II, &c. the afternoon hour. Also let C be the position of the bottom of the stile, on any given day; and A any hour point; join AC, then AC will be the position of the shadow of the stile corresponding to the hour point A on that day. Therefore if we recur to the notation employed in the solution of the problem in last article, and express the time from noon by ϕ, then the angle at C will be θ, and so we shall have

$$\text{Cot. C}=\frac{\text{Cos. }(\varepsilon-\lambda)\text{ cos. }\phi-\text{sin. }(\varepsilon-\lambda)\text{ tan. }\delta}{\text{Sin. }\varepsilon\text{ sin. }\phi}.$$

Draw AB perpendicular to the meridian; put $OB=x$, and $AB=y$, (so that x and y are the co-ordinates of any hour point,) and put v for OC, the variable distance of the bottom of the stile from the fixed point O, in the plane of the dial; then $BC=x-v$; and because AB : BC : : rad.: cot. C, that is $y : x-v : : 1 :$ cot, θ, we have

$$\text{cot. }\theta=\frac{x-v}{y},\text{ and}$$

$$\frac{x-v}{y}=\frac{\text{Cos. }(\varepsilon-\lambda)\text{ cos. }\phi-\text{sin. }(\varepsilon-\lambda)\text{ tan. }\delta}{\text{Sin. }\varepsilon\text{ sin. }\phi};$$

and hence we find,

$$v=\left\{\begin{array}{l}\dfrac{x\text{ sin. }\varepsilon\text{ sin. }\phi-y\text{ cos. }(\varepsilon-\lambda)\text{ cos. }\phi}{\text{Sin. }\varepsilon\text{ sin. }\phi}\\[2ex] +\dfrac{y\text{ sin. }(\varepsilon-\lambda)}{\text{sin. }\varepsilon\text{ sin. }\phi}\text{ tan. }\delta.\end{array}\right.$$

The nature of the dial requires that the position of the stile should depend entirely on the sun's declination, without any regard to a particular hour of the day; and also that the position of the hour points should depend entirely on the hour of the day, without any regard being had to the sun's declination: But these two conditions will manifestly be satisfied, if, in the last equation, we make

$$x\text{ sin. }\varepsilon\text{ sin. }\phi-y\text{ cos. }(\varepsilon-\lambda)\text{ cos. }\phi=0;$$

and at the same time put

$$\frac{y\text{ sin. }(\varepsilon-\lambda)}{\text{Sin. }\varepsilon\text{ sin. }\phi}=a,\text{ a constant quantity,}$$

for then we shall have x and y both independent of δ, the declination, and $v=a$ tan. δ a quantity independent of ϕ, as they ought to be.

By resolving our two assumed equations in respect of x and y, we readily find

$$x=a\frac{\text{Cos. }(\varepsilon-\lambda)}{\text{Sin. }(\varepsilon-\lambda)}\text{cos. }\phi\;.\;.\;.\;.\;.\;(A)$$

$$y=a\frac{\text{Sin. }\varepsilon}{\text{Sin. }(\varepsilon-\lambda)}\text{sin. }\phi\;.\;.\;.\;.\;.\;(B)$$

$$v=a\text{ tan. }\delta.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;(C)$$

These three equations express completely the nature of every dial of this kind, and are sufficient for its construction, nothing more being necessary than to assume for a a line of any length whatever, as a scale on which the parts of the dial are to be measured; then to compute x and y from the formulas (A), (B), by making $\phi=15^0$ for the hour lines of XI and I, and $\phi=30^0$ for those of X and II, and so on; and lastly, to form a graduated scale along the meridian line, proceeding both ways from O, that point being the position of the stile at the time of either equinox: And as, by considering Fig. 34, it will readily appear that for any given hour the angle θ, (or C on the dial,) ought to increase as the sun approaches the north pole; the scale of declination for the north side of the equator must lie on the north side of O, and that for the south side of the equator on the south side of O. The months and days of the year ought also to be placed on the scale opposite to the degrees of declination to which they correspond.

85. From the equations (A) (B), of last article, we find,

$$x^2=\frac{a^2\text{ cos.}^2\,(\varepsilon-\lambda)}{\text{Sin.}^2\,(\varepsilon-\lambda)}\text{cos.}^2\,\phi,$$

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$$\frac{y^2 \cos.^2 (\varepsilon-\lambda)}{\text{Sin.}^2 \varepsilon} = \frac{a^2 \cos.^2 (\varepsilon-\lambda)}{\sin.^2 (\varepsilon-\lambda)} \sin.^2 \phi ;$$

Hence, by adding we find,

$$x^2+\frac{y^2 \cos.^2 (\varepsilon-\lambda)}{\sin.^2 \varepsilon}=\frac{a^2 \cos.^2 (\varepsilon-\lambda)}{\sin.^2 (\varepsilon-\lambda)} \ldots \text{(D)}.$$

But this equation manifestly belongs to an ellipse, the co-ordinates to the axes of which are x and y; hence we have an elegant property of the hour points on these dials, namely, that they are all in the perimeter of an ellipse, of which

$$\left.\begin{array}{l} \text{The merid. semi-axis} = \dfrac{a \cos. (\varepsilon-\lambda)}{\sin. (\varepsilon-\lambda)} \\ \text{The other semi-axis} = \dfrac{a \sin. \varepsilon}{\sin. (\varepsilon-\lambda)} \end{array}\right\} \ldots \text{(E)}$$

The Analemmatic or Azimuth Dial.

The analemmatic or azimuth dial.

86. The analemmatic dial is constructed on the principles which we have explained, art. 83—86. Its stile is vertical; therefore recurring to the notation and formulas of these articles, we have $\varepsilon=90^\circ$; and hence the equations of the dial are,

$$x=a \tan. \lambda \cos. \phi ;$$
$$y=a \sec. \lambda \sin. \phi ;$$
$$v=a \tan. \delta.$$

The dimensions of the ellipse which passes through its hour points, are these,

Semiconj. or merid. axis $=a$ tan. λ;
Semitransverse axis . . $=a$ sec. λ;
Eccentricity . . . . . $=a$.

Plate CCXXX. Fig. 1.

The values of x, y, v, are all the elements wanted to construct the dial, either arithmetically or geometrically. The geometrical construction may be as follows. See Fig. 1.

1. Draw two straight lines Aa, Bb, intersecting each other at right angles in O.

2. In OA, one of these lines, take OD of any suitable length for the eccentricity of the dial; and at the point D draw DB, so as to make with DO an angle equal to the latitude of the place. Then OB shall be half the lesser axis, and B the 12 o'clock hour point.

3. In OD take OA and Oa, each equal to DB; and Aa shall be its greater axis, and Aa the six o'clock hour points.

4. On O as a centre, with OA and OB as radii, describe circles, and divide the quadrants that are in the same angle, each into six equal parts, as in the Figure.

5. From K, any one of the points of division in the outer circle, draw KL perpendicular to OA; and from k, the corresponding point in the inner circle, draw kN parallel to OA, meeting KL in N, which will be one of the hour points, and in the same way may all the others be found, as is shewn in the Figure.

6. At the point D make angles ODE, ODe each $23\frac{1}{2}$ degrees, the sun's greatest declination; and E, e, shall be the positions of the bottom of the stile, at the summer and winter solstices, the former lying on the north, and the latter on the south side of O, the middle of the dial.

7. Describe a circle with DO as a radius, and find the tangents of the series of arcs, 1°, 2°, 3°, &c. to 23° of that circle, and lay them as a scale from O to E, and e in each side of O.

8. Find in the Tables, p. 715. the sun's declination on the first day of every month, and mark the beginning of the month on the scale Ee, opposite to its corresponding degree of declination. As many of the intermediate days as there may be room for, may in like manner be marked on the scale.

9. The stile must now, by some mechanical contrivance, be placed over the scale so as to admit of being moved along it, and set to any day, and the dial is finished.

To prove that the hour points have their proper position, let x=LN, y=OL, ϕ=angle HOK; then because

rad. : cos. ϕ : : KO : KL : : kO ($=a$ tan. λ) : NL($=x$),
and rad. : sin. ϕ : : KO ($=a$ sec. λ) : OL ($=y$)
we have $x=a$ tan. λ cos. ϕ, and $y=a$ sec. λ sin. ϕ, as they ought to be.

This dial was given by Vaulezard, in 1644, in a French work called *Traité de l'origine, Demonstration, Construction, et Usage du Quadrant Analemmatique.* It made also the principal object of Forster's *Elliptical Horologiography*, published at London, in 1654. It is sometimes joined to horizontal dials, to which it is an elegant appendage; because the shadows on the two dials can, in general, only indicate the same hour, when both stiles are in the plane of the meridian; and hence the compound dial can be placed in a proper position, without the help of a compass or meridian line. Fig. 2. represents a dial of this construction. It has the advantage of not being subject to the error of refraction. Plate CCXXX. Fig. 2.

Lambert's Dial.

Lambert's dial.

87. M. Lambert remarked in the Berlin Ephemerides for 1777, that a dial, with a moveable centre, might be constructed, in which the hour points should stand at equal distances, on the circumference of a circle. It is easy to see that this is possible; for the general expressions (E), for the semiaxes of the ellipse in which the hour points are situated in this kind of dial, being, by art. 85,

$$\frac{a \cos. (\varepsilon-\lambda)}{\sin. (\varepsilon-\lambda)}, \quad \frac{a \sin. \varepsilon}{\sin. (\varepsilon-\lambda)} ;$$

if we suppose ε, the elevation of the stile, to be such that cos. $(\varepsilon-\lambda)$=sin. ε; the axes of the ellipse will be equal, and it will become a circle. This condition requires that $\varepsilon-\lambda+\varepsilon=90^\circ$; from which we find,

$$\varepsilon=\tfrac{1}{2} (90+\lambda) ;$$
$$v=a \tan. \delta ;$$
$$\text{rad. of dial}=a \tan. \tfrac{1}{2} (90+\lambda).$$

In the latitude of Edinburgh, which is $55^\circ 58'$, the elevation of the stile of a dial of this kind would be $\frac{1}{2}(90^\circ+55^\circ 58')=72^\circ 59'$. The geometrical construction of this dial is extremely simple.

1. Take a straight line OD (Fig. 3.) of any length, and at O one of its extremities draw OB perpendicular to it. Fig. 3.

2. At the point D, make the angle ODB equal to half the sum of 90°, and the latitude of the place; and OB will be the radius of the dial.

3. Describe a circle on O as a centre, and divide each quadrant into six equal parts, and the points of division will be the hour points of the dial.

4. Draw two lines DE, De, and make a scale of tangents of the sun's declination from O to E and e, and against the divisions of the scale write the days of the month, as described in the analemmatic dial.

5. Place the stile over the meridian, so that it may admit of being adjusted to the time of the year exactly, as in the analemmatic dial, and so that it may make with the horizon an angle equal to BDO, and the dial will be constructed.

Note. The style must be on the north or south side of the point O, according as the sun is on the north or south side of the equator.

If the shifting of the position of the stile in these di-

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als should be considered an inconvenience, it may be avoided, by putting different sets of hour points on the dial, corresponding to different times of the year, just as if the hour points were shifted, so as to suit the style, instead of adapting the style to the position of the hour points.

Having now explained the general theory of dials, as well as the most common and useful of them, upon strictly geometrical principles, we shall now describe some others; but the limits of our work will not allow us to enter so minutely into the mathematical investigation.

Portable Dial on a Card.

Portable dial on a card.

Plate CCXXX. Fig. 4, 5.

88. This dial is represented in Figs. 4. and 5. Its geometrical construction is as follows:

1. Draw a straight line 12 CA parallel to the top of the card, (Fig. 4.) and draw another line kC6, bisecting the former at right angles. On C as a centre, with any convenient radius, describe a semicircle 12, 6, A, and divide it into twelve equal parts at the points 11, 10, 9, 8, &c.

3. From the points 11, 10, 9, 8, &c. draw lines perpendicular to the diameter 12 A; and these will be the hour lines. The half hours and quarters may also be drawn, by dividing each arc into four equal parts.

4. At 12, the extremity of the diameter, draw a line 12 k, to make with 12CA an angle equal to the latitude of the place; let this line meet the 6 o'clock hour line in k, through which draw a line BkD perpendicular to 12k.

5. At the point 12, draw lines 12B, 12D, to make each, with 12k, an angle of 23½ degrees, the sun's greatest declination. These lines determine the length of BD, the scale of the months.

6. Describe a semicircle on BD as a diameter, divide it into six equal parts at H, I, K, L, M, and draw lines Hh, Ii, Kk, Ll, Mm, perpendicular to BD. These points are the centres of the arcs of the signs.

7. On B and D as centres, describe arcs 12 ♑, 12 ♋, to pass through the point 12, and these will be the tropics. Also on h and m as centres, describe arcs to pass through 12, and the one will be the arc of the signs ♒ and ♐, and the other the arc of the signs ♊ and ♌. And on i and l as centres, describe arcs through 12, and the one will be the arc of the signs ♓ and ♏, and the other the arc of the signs ♍ and ♉. And lastly, describe an arc on k as a centre, to pass through 12, and it will be the arc of the signs ♈ and ♎.

8. On the point 12 as a centre, describe an arc of a circle OPQ, terminating in the lines 12B, 12D, and divide each half PO, PQ, into 23½ equal parts; then the arc OPQ is a scale of the sun's declination.

9. Find from a table the sun's declination for every 5th day of the year, and laying a ruler over the point 12 and the degree of each day, on the scale OQ, mark the point in which the ruler meets BD; and against the points of division for the days of each month write the name of the month, (see Fig. 5.) observing, that the days from 21st March to 23d September must lie on the left hand side of k, the middle of the scale.

Fig. 5.

10. Cut a slit through the card along the line BD, and through it put a thread, having a bead sliding along it, and a plummit at one end, which hang along the face of the dial when it is held vertically, and make a knot on the other end of the thread at the back of the dial, so that it may not be drawn through the slit.

11. Draw a line N v parallel to CA, and at one end of the line cut slits along vx, xy, yz, three sides of a rectangle, through the card, so as to admit of its turning about the remaining side vz as a hinge. This rectangle is the *gnomon* of the dial, and the line VN is the shadow line. The manner of placing the hours conveniently against the hour lines, and forming the scale of months, will easily be understood by inspecting Fig. 5, which shews the dial completely finished.

89. To rectify the dial, set the thread in the slit right against the day of the month, and stretch it over the angular point where the circles meet at XII, then shift the bead to that point of the thread, and the dial is rectified.

To find the hour of the day, raise the gnomon, (no matter how much or how little,) and hold the edge of the dial next the gnomon towards the sun, so that the uppermost edge of the shadow of the gnomon may just cover the *shadow line*; and the bead then moving freely on the face of the dial by the weight of the plummet, will shew the time of the day among the hour lines as it is forenoon or afternoon.

Note. The dial will evidently indicate the hour, but imperfectly, near noon; but it does not seem that this evil can be avoided in an altitude dial.

To find the time of sun rising and setting. Having rectified the dial for the given day, move the thread among the hour lines, until it either covers some one of them, or lies parallel betwixt any two, and then it will cut the time of sun rising among the forenoon hours, and the time of sun setting among the afternoon hours.

To find the sun's declination, stretch the thread from the day of the month over the angular point at XII. and it will indicate the declination on the graduated arch.

To find on what days the sun enters the signs. When the bead, as above rectified, moves along any of the curve lines, which have the signs of the zodiac marked upon them, the sun enters those signs on the days pointed out by the thread in the scale of months.

Montucla, in his *Mathematical Recreations*, says, that this dial originated from an universal rectilineal dial constructed by Father de Saint-Rigaud, a Jesuit, and professor of mathematics in the college of Lyons. He also observes that it is generally called the Capuchin, because it resembles the head of a Capuchin friar with the cowl inverted.

Dial on a Cylinder.

Dial on a cylinder.

Plate CCXXX. Fig. 6.

90. This dial is shewn in Fig. 6. It indicates the hour of the day, the sun's place in the ecliptic, and his altitude at any time of observation. The dial is constructed by tracing the lines on paper, and pasting it round the surface of the cylinder. The lines may be drawn by the following rules:

Fig. 7.

1. Draw a line AaB (Fig. 7.) parallel to the top of the paper, and on a as a centre, with any convenient radius, describe the quadrantal arc AE, and divide it into 90 equal parts or degrees.

2. Draw AC perpendicular to AB, touching the quadrant at A, and from a draw lines through as many degrees of the quadrant as are equal to the sun's altitude at noon on the longest day of the year, at the place for which the dial is to serve, (this is always equal to the sum of 23½ degrees, and the complement of the latitude,) and continue those lines until they meet the tangent AC; from the points of intersection draw lines across the paper parallel to AB, and they will be the parallels of the sun's altitude in whole degrees, from sunrise to sunset, on all the days of the year. (In the Figure, we have only drawn every fifth degree. These lines must be drawn out to the right line BD, which

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must be parallel to AC, and as far from it as is equal to the intended circumference of the cylinder.

Dial on a cylinder.

Plate CCXXX. Fig. 6, 7.

3. Divide the space between AC and BD (at the top and bottom) into 12 equal parts, for the signs of the ecliptic, and from mark to mark of these divisions draw lines, which will be parallel to AC and BD, and place the characters of the twelve signs on these twelve spaces at the bottom, as in the Figure. The spaces between the signs may be subdivided into halves, and, if there be room, into quarters.

4. At the top of the dial, make a scale for the months and days of the year, so as the days may stand over the sun's place for each of them, in the signs of the ecliptic. The sun's place must be taken from an ephemeris.

5. Compute the sun's altitude for every hour, in the latitude of your place, when it enters each sign of the ecliptic, and also when it is in the middle of the sign, and in the upright parallel lines at the beginning and middle of each sign, make marks for those computed altitudes among the horizontal parallels of altitude, reckoning them downwards, according to the order of the numeral figures set to them at the right hand, answering to the like division of the quadrant at the left, and through these marks draw the curve hour lines, and set the hours to them, as in the Figure, reckoning the forenoon hours downward, and the afternoon hours upward. The sun's altitude should also be computed for the half hours; and the quarter hour lines may be drawn very nearly in their proper places by estimation and accuracy of the eye. Then cut off the paper at the left hand close by the line AC, and also the paper on the right hand close by the line BD, and cut it also close by the top and bottom horizontal lines, and it will be fit for pasting round the cylinder.

This cylinder (Fig. 7.) should be hollow, to hold the stile DE when it is not used. The crooked end of the stile is put into a hole in the top AD of the cylinder, and the top goes on tightish, but must be made to turn round on the cylinder like the lid of a paper snuff box. The stile must stand straight out, perpendicular to the side of the cylinder, just over the right line AB, where the parallels of the sun's altitude begin; and the length of the stile, or distance of its point *c* from the cylinder, must be equal to the radius *a*A of the quadrant. (Fig. 7.)

91. To use this dial, place the horizontal base BC of the cylinder on a level table, where the sun shines, and turn the top AD, till the stile stands just over the day of the then present month. Then turn the cylinder about on the table, till the shadow of the stile falls on it, parallel to those upright lines which divide the signs; that is, till the shadow be parallel to a supposed axis in the middle of the cylinder, and then the point, or lowest shadow, will fall upon the time of the day as it is before noon or afternoon, among the curve hour lines, and will shew the sun's altitude at that time among the cross parallels of his altitude, which go round the cylinder, and at the same time it will indicate the sign of the ecliptic in which the sun is. The degree of the sign may be estimated nearly by the eye.

The dial may also be suspended by the ring F at the top, and when it is not used, the stile may be drawn out, and put into the cylinder.

Ring Dial.

Ring dial.

91. Ring dials are another variety of the kind that indicates the hour by the sun's altitude. They are very common; but those generally sold are inaccurate in the principle of their construction, for the hours are usually marked in the inside on one line, and a narrow moveable band, with a hole in it, is shifted till the hole correspond with the degree and sign of the sun's place marked on the outside. Instead of one circle, there ought to be seven distinct circles on the concave surface of the ring, to represent as many parallels of the sun's entrance into the signs; and on each, there must be marked the sun's altitude on its entrance into the sign belonging to the parallel to which the circle corresponds. When these points are marked, they must be joined by curves, which will be the real hour lines.

Plate CCXXX. Fig. 8.

Having provided a ring (Fig. 8.), or rather described a circle of the same size as the ring which is to be divided, and having fixed on B as the point of suspension, make BA and BO, on each side of B, equal to the latitude of the place; that is, equal to the distance of the zenith from the equator. Then through the points A and O draw the chord AO, and AD perpendicular to it: If the line A 12 be then drawn through A, and the centre of the circle, the point 12 will be the hour of noon on the day of the equinox.

To find the other hour-points for the same day at the commencement of Aries and Libra; from the centre A describe the quadrant OD; and from O set off towards P, the sun's altitude at different hours of the day; as at 1 and 11, 2 and 10, &c. The lines drawn from the centre A through these points of division, if continued to the circumference of the circle B 12 A, will give the hour-points of the day of the equinox.

To obtain the hour-divisions on the circles corresponding to the other signs; first set off on both sides of the point A (Fig. 9.), the sun's declination when he enters each of the signs, viz. the arcs AE and AI of 11° 30′ for the commencement of Taurus or Virgo, of Scorpio or Pisces; AF of 20° 13′ for the commencement of Gemini and Leo; AK equal to it for the commencement of Sagittarius and Aquarius; and AG and AL of 23° 30′ for the commencement of Cancer and Capricorn. Fig. 9.

Now, to find the hour-points on the circle, that corresponding to the commencement of Aquarius, for example; through the point K, which corresponds to the sun's entrance into that sign, draw KP parallel to AO, and also the line K 12: From the same point K describe between K 12, and the horizontal line KP, the arc QR, on which set off from R towards Q, the sun's altitude at the different hours of the day when he enters Sagittarius and Aquarius, as seen in the Figure; and if lines be drawn from K to these points of division, you will have the hour-points of the two circles corresponding to the commencement of Sagittarius and Aquarius. By proceeding in the same manner for the sun's entrance into the other signs, you will have the hour-points in the circles which correspond to them.

Then trace out on the concave surface of the circles seven parallel circles (Fig. 10.), that in the middle for the equinoxes; the two next on each side for the commencement of Taurus and Virgo, Scorpio and Pisces; the following two on the right and left for Gemini and Leo, Sagittarius and Aquarius; and the last two for Cancer and Capricorn: If the similar hour-points be joined by a curve line, the ring dial will be completed. Fig. 10.

The next thing to be done, is to adjust properly the hole which admits the solar rays; for it ought to be moveable, so that on the day of the equinox it may be at the point A; on the day of the summer solstice at G; on the day of the winter solstice at L; and on the other days of the year in the intermediate positions. For this purpose, the exterior part of the ring must

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have in the middle of it a groove, to receive a small moveable ring with a hole in it. The divisions K, L, I, A, E, F, G must be marked on the outside of this part of the ring by parallel lines, inscribing on one side the ascending signs, and on the other the descending. When this construction has been made, it will be easy to place the hole of the moveable part A in the proper division; or at some intermediate point; for if the ring be pretty large, each sign may be divided into two or three parts.

To know the hour; move the hole A to the proper division, according to the sign and degree of the sun's place; then turn the instrument in such a manner, that the sun's rays passing through the hole may fall on the circle corresponding to the sign in which the sun is: the division on which it falls will shew the hour.

To render the use of this instrument easier, instead of the divisions of the signs, the days on which the sun enters them might be marked on it. For example, June 21. instead of ♋, &c.

Universal Dial on a Cross.

Universal dial on a cross. Plate CCXXX.

90. A dial is said to be *universal*, when, by adjustment, it indicates the hour in any latitude whatever. The equinoctial dial described in art. 37. is of this kind, for, from its construction, it can readily be adjusted to any latitude whatever.

Fig. 11.

The universal dial on a cross is represented by Fig. 11. It is moveable on a joint C, for elevating it to any given latitude on the quadrant CO *g o*, as it stands upon the horizontal board A. The arms of the cross stand perpendicular to the middle part; and the top of it, from *a* to *n*, is equal in length to either of the arms *n e* or *m k*.

Having set the middle line *t u* to the latitude of your place on the quadrant, the board A level, and the point N northwards by the needle, (allowing for the variation); the plane of the cross will be parallel to the plane of the equator; and the dial will be adjusted. Then from III o'clock in the morning till VI, the upper edge *k l* of the arm will cast a shadow on the time of the day on the side of the arm *c m*; from VI till IX, the lower edge *i* of the arm *i o* will cast a shadow on the hours on the side *o q*. From IX till XII at noon, the edge *a b* of the top *a n*, will cast a shadow on the hours on the arm *n e f*. From XII till III in the afternoon, the edge *c d* of the top part will cast a shadow on the hours on the arm *k l m*; from III to VI in the evening, the edge *g h* will cast a shadow on the hours on the parts *p s*; and from VI till IX, the shadow of the edge *e f* will shew the time on the top *a n*.

The breadth of each part *a b*, *e f*, &c. must be so great as never to let the shadow fall quite without the part or arm on which the hours are marked, when the sun is at his greatest declination from the equator. The shadow will always fall within the arm *e f*, making its length *n e* the radius of a circle, the breadth *e f* exceed the tangent of $23\frac{1}{2}°$ of that circle; that is, it ought not to be less than about $\frac{44}{100}$ parts of the length: but that the shadow may fall within the quarter divisions of the hours when it comes near the end of the arm, it ought to be almost double that breadth.

As the cross lies in the plane of the equinoctial, the dials on its arms will be horizontal dials for the equator, and those on its sides east and west dials there. Hence the hour lines may be found as follows:

Lay the cross on a sheet of paper, and trace its shape, as in Fig. 12, with a black-lead pencil. Then on *a*, a corner of one of the arms with a radius equal to *a e*, the length of the arms, describe the quadrantal arc *e f*. Divide the quadrant into six equal parts at *g h i*, &c. and draw lines from *a* through the points of division to meet the arm in 1, 2, 3, and these are all the hour-lines that can fall upon it. Divide each of the other arms for the three hours it contains in the same manner; and set the hours to the sides of the arms in their proper places, as marked in Fig. 11. The divisions for the quarter hours may be found, by dividing the arcs *e g*, *g h*, *h i* into four equal parts.

Description of Dials. Plate CCXXX. Fig. 12. Fig. 11.

An Universal Dial, shewing the Hours by a Terrestrial Globe, and by several Gnomons.

91. This dial, which seems to have been invented by the very ingenious Mr James Ferguson, may be made of a thick square piece of wood, or hollow metal. The sides are cut into semicircular hollows, in which the hours are placed: The stile of each hollow coming out from the bottom thereof, as far as the ends of the hollows project. The corners are cut into angles, in the insides of which the hours are also marked; and the edge of the end of each side of the angle serves as a stile for casting a shadow on the hours marked on the other side.

Universal dial, shewing the hours by a terrestrial globe, and by several Gnomons. Plate CCXXX. Fig. 14.

In the middle of the uppermost side or plane there is an equinoctial dial: in the centre whereof an upright wire is fixed, for casting a shadow on the hours of that dial, and supporting a small terrestrial globe on its top.

The whole dial stands on a pillar, on the middle of a round horizontal board, in which there is a compass and magnetic needle, for placing the meridian stile towards the south. The pillar has a joint with a graduated quadrant upon it, (supposed to be hid from sight under the dial in the Figure,) for setting it to the latitude of any given place.

The equator of the globe is divided into 24 equal parts, and the hours are laid down upon it at these parts. The time of the day may be shewn by these hours, when the sun shines upon the globe.

To rectify and use this dial, set it on a level table, or sole of a window, where the sun shines, placing the meridian stile due south, by means of the compass needle, making allowance for its variation; or better, by means of a meridian line drawn upon the side of the window. Then bend the pillar in the joint till the axis of the upper dial make with the plane of the horizon an angle equal to the latitude of the place, as measured on the quadrant. When the machine is thus rectified, its plane will be parallel to the equator, and the axis that supports the globe will point to the north pole of the heavens. The same hour will then be shewn in several of the hollows, by the ends of the shadows of their several stiles. The shadow of the axis of the globe will shew the hour on the equinoctial dial, from the 20th of March to the 22d of September; and if the meridian of the place on the globe be set even with the meridian stile, all the parts of the globe that the sun shines upon will answer to those places of the real earth which are then enlightened by the sun. And if the hour of VI be marked on the equator in the meridian of your place, the division of the light and shade on the globe will shew the time of the day.

The construction of this dial is as follows: on a thick square piece of wood, or metal, draw the lines *a c* and *b d*. (Fig. 14.) as far from each other as you in- Fig. 14.

Description of Dials.

tend the thickness of the stile $a\,b\,c\,d$; and in the same manner draw the like thickness of the three other stiles $e\,f\,g\,h$, $i\,k\,l\,m$ and $n\,o\,p\,q$, all standing outright as from the centre.

Plate CCXXX. Fig. 14.

On a as a centre, with any convenient radius a A (which leaves proper strength of stuff when KI is equal to a A) describe the quadrantal arc A c; and with the same radius, on b as a centre, describe the quadrantal arc d B. All the quadrantal arcs in the Figure are to be described with the same radius, and in the same manner, on their centres $e\,f$, $i\,k$, and $n\,o$, and each quadrant is to be divided into six equal parts, for as many hours as in the Figure, each of which may be subdivided into four for the half hours and quarters. At equal distances from each corner, draw the right lines I P and Kp, L q and M q, N r and O r, P s and Q s, to form the four angular hollows I p K, L q M, N r O, and P s Q, making the distances between the tips of the hollows, as IK, LM, NO and PQ, each equal to the radius of the quadrants, and leaving room within the angular points p, q, r, and s, for the equinoctial circle in the middle.

To divide the insides of these angles properly for the hour spaces thereon; on K and I as centres, with KI as a radius, describe the arcs K t, I t, meeting in t. Divide each arc into four equal parts, and from their centres, through the points of division, draw the right lines I 3, I 4, I 5, I 6, I 7, and K 2, K 1, K 12, K 11; and they will meet the sides Kp, and I p, where the hours thereon must be placed, and these hour spaces in the arcs must be subdivided into half hours and quarters. Do the like for the other three angles, and draw the dotted lines, and set the hours in the insides where those lines meet them, as in the Figure; and the like hour lines will be parallel to each other in all the quadrants and in the angles.

Mark points for all these hours on the upper side, and cut out all the angular hollows, and the quadrantal ones, quite through the places where the four gnomons are to stand; and lay down the hours on their insides, as in Fig. 49, and then set in their four gnomons, which must be as broad as the dial is thick; and this breadth and thickness must be large enough to keep the shadows of the gnomons from ever falling quite out at the sides of the hollows, even when the sun's declination is at the greatest. Lastly, draw the equinoctial dial in the middle, all the hours of which are equidistant from each other, and the dial will be finished.

Babylonian and Italian Dials.

Babylonian and Italian dials.

92. The hours of these dials are not reckoned from noon, as with us, but on a Babylonian dial they are reckoned from sunrise to sunrise, and on an Italian dial from sunset to sunset. Thus, in Italy, the hour before sunset is the 23d hour of the day; and the second hour before sunset is the 22d hour, and so on. As the time of sunrise is continually varying, the beginning of the day (and consequently the time from noon at which any one of the hours shewn by these dials happens) is never the same on two succeeding days; the hours however are all equal. As both dials must be constructed on the same principles, it will be sufficient if we explain a particular case of one of them.

Fig. 15.

The hour is shewn by the shadow of the top of an upright stile, which is commonly the extremity of the axis of a common dial. Let us suppose that Fig. 15. represents a vertical south dial, on which it is proposed to trace the Babylonian hours; FC being the upright stile, and P the centre of the dial.

Find the hour next following sunrise, when the sun describes either tropic; for example, let it be four in summer, and eight in winter. Find next the sun's declination when he rises at these hours, and trace on the dial the hyperbolic curves $m\,m$, $n\,n$, which are the paths of the shadow when the sun has those declinations. Trace also the paths of the shadow when the sun describes the tropics: these last are only of use to terminate the hour lines when drawn on the dial.

Observe all the points where the hour lines of the dial cut the south parallel $m\,m$, then since the Babylonian hours proceed from 1 to 24, and in this parallel the sun rises at 8, therefore write 24 at that point of the parallel, where the 8 o'clock line passes, and write 1 at 9, 2 at 10, 3 at 11, &c.

Again, observe all the points where the hour lines of the dial cut the northern parallel $n\,n$; and since here the sun rises at 4, call that 24, at 5 write 1, at 6 write 2, at 7 write 3, at 8 write 4, at 9 write 5, at 11 write 7, at 12 write 8, and so on.

Next draw straight lines joining those points of $m\,m$, $n\,n$ the paths of the shadow which are marked with the same number, as 22, 33, 44, 55, and these are the Babylonian hour lines; that is, the shadow of the end of the stile will always be somewhere on the line 11, one hour after sunrise; it will be on the line 22, two hours after sunrise, and so on.

To understand the theory of this construction, we must consider that all the points of the sphere at which the sun is seen at sunrising, at different times of the year, are in the circumference of a great circle; and therefore its positions at one hour after sunrise, or at two hours after sunrise, &c. must also be in great circles. But with a little consideration it will appear that the extremities of the shadows projected by the gnomon, when the sun is at different points in a great circle, must all lie in a straight line, which will be the common section of that circle, and the plane of the dial; therefore the Babylonian hour lines must be straight lines, and two points in any one of them being known, the line itself is known; hence the truth of the construction is obvious.

As the hyperbolic lines $m\,m$, $n\,n$, are only of use in determining the hour lines, they need not appear on the dial.

Jewish Dial.

Jewish dial.

93. The *Jewish* hours, called the *naturals*, and also the *planetary* hours, begin at sunrise, and twelve are reckoned until sunset; hence they are all equal on the same day, but their length varies from day to day.

To delineate a dial of this kind, the paths of the shadow must be traced when the sun is in the tropics, and also in several intermediate points. The times of the day (reckoned according to the usual method) must be found at which the different Jewish hours happen, when the shadow describes each path; and the position of the shadow in its path must be found at the commencement of each Jewish hour. If curve lines be now traced through the same Jewish hour on all the hyperbolic paths, these curves will be the hour lines of the dial. The time is indicated by the shadow of the top of the stile, exactly as in the Babylonian dial.

The subject of dialling will be again adverted to, when we come to treat of the gnomonical projection of the sphere. See Projection of the Sphere. (ξ)

Dialling Tables.

Dialling Tables.

TABLE,

Shewing the Sun's Place and Declination, and the Equation of Time for every Day of the Year, calculated for the Second Year after Leap Year.

January.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♑10° 27′	23° 3′S.	3′ 48″+	1
2	11 28	22 58	4 16	2
3	12 29	22 53	4 44	3
4	13 31	22 47	5 12	4
5	14 32	22 40	5 39	5
6	15 33	22 34	6 6	6
7	16 34	22 26	6 33	7
8	17 35	22 19	6 59	8
9	18 37	22 10	7 24	9
10	19 38	22 2	7 49	10
11	20 39	21 53	8 13	11
12	21 40	21 43	8 37	12
13	22 41	21 33	9 0	13
14	23 42	21 23	9 22	14
15	24 43	21 12	9 44	15
16	25 44	21 1	10 4	16
17	26 46	20 50	10 25	17
18	27 47	20 38	10 44	18
19	28 48	20 25	11 3	19
20	29 49	20 13	11 21	20
21	♒ 0 50	20 0	11 38	21
22	1 51	19 46	11 55	22
23	2 52	19 32	12 11	23
24	3 53	19 18	12 26	24
25	4 54	19 4	12 40	25
26	5 55	18 49	12 53	26
27	6 56	18 34	13 6	27
28	7 57	18 18	13 18	28
29	8 58	18 2	13 29	29
30	9 58	17 46	13 39	30
31	10 59	17 30	13 49	31

February.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♒12° 0′	17° 13′S.	13′ 58″+	1
2	13 1	16 56	14 5	2
3	14 2	16 38	14 12	3
4	15 3	16 20	14 19	4
5	16 4	16 2	14 24	5
6	17 4	15 44	14 28	6
7	18 5	15 26	14 32	7
8	19 6	15 7	14 34	8
9	20 7	14 48	14 37	9
10	21 7	14 28	14 38	10
11	22 8	14 9	14 39	11
12	23 9	13 49	14 38	12
13	24 9	13 29	14 37	13
14	25 10	13 9	14 35	14
15	26 10	12 49	14 33	15
16	27 11	12 28	14 29	16
17	28 11	12 7	14 25	17
18	29 12	11 46	14 20	18
19	♓ 0 12	11 25	14 15	19
20	1 12	11 3	14 8	20
21	2 13	10 42	14 2	21
22	3 13	10 20	13 54	22
23	4 13	9 58	13 46	23
24	5 14	9 36	13 37	24
25	6 14	9 14	13 28	25
26	7 14	8 52	13 18	26
27	8 14	8 29	13 8	27
28	9 15	8 7	12 57	28

In these Tables, N. signifies North, and S. South Declination. The Signs + and —, denote that the equation of time must be added to, or subtracted from, the time shewn by a sun dial, or apparent time, in order to obtain the mean time, or the time shewn by a well-regulated clock or watch.

Dialling Tables.

TABLE,

Shewing the Sun's Place and Declination, and the Equation of Time for every Day of the Year, calculated for the second Year after Leap Year.

Dialling Tables.

MARCH.

Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♓10° 15′	7° 44′S.	12′ 45″+	1
2	11 15	7 21	12 33	2
3	12 15	6 58	12 21	3
4	13 15	6 35	12 8	4
5	14 15	6 12	11 54	5
6	15 15	5 49	11 40	6
7	16 15	5 26	11 26	7
8	17 15	5 2	11 14	8
9	18 15	4 39	10 56	9
10	19 15	4 16	10 41	10
11	20 15	3 52	10 25	11
12	21 15	3 29	10 9	12
13	22 14	3 5	9 52	13
14	23 14	2 41	9 35	14
15	24 14	2 18	9 18	15
16	25 13	1 54	9 1	16
17	26 13	1 30	8 43	17
18	27 12	1 7	8 25	18
19	28 12	0 43	8 7	19
20	29 11	0 19	7 49	20
21	♈ 0 11	0 4N.	7 31	21
22	1 10	0 28	7 12	22
23	2 10	0 52	6 54	23
24	3 9	1 15	6 35	24
25	4 9	1 39	6 17	25
26	5 8	2 2	5 53	26
27	6 7	2 26	5 39	27
28	7 6	2 50	5 21	28
29	8 6	3 13	5 2	29
30	9 5	3 36	4 44	30
31	10 4	3 59	4 24	31

APRIL.

Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♈11° 3′	4° 23′ N.	4′ 7″+	1
2	12 2	4 46	3 49	2
3	13 1	5 9	3 31	3
4	14 0	5 32	3 13	4
5	14 59	5 55	2 55	5
6	15 58	6 17	2 37	6
7	16 57	6 40	2 20	7
8	17 56	7 3	2 2	8
9	18 55	7 25	1 45	9
10	19 54	7 47	1 28	10
11	20 53	8 9	1 12	11
12	21 51	8 31	0 55	12
13	22 50	8 53	0 39	13
14	23 49	9 15	0 23	14
15	24 47	9 37	0 8	15
16	25 46	9 58	0 7—	16
17	26 44	10 19	0 22	17
18	27 43	10 40	0 36	18
19	28 41	11 1	0 50	19
20	29 40	11 22	1 4	20
21	♉ 0 38	11 43	1 17	21
22	1 37	12 3	1 30	22
23	2 35	12 23	1 42	23
24	3 33	12 43	1 54	24
25	4 32	13 3	2 5	25
26	5 30	13 22	2 16	26
27	6 28	13 42	2 26	27
28	7 27	14 1	2 36	28
29	8 25	14 20	2 45	29
30	9 23	14 38	2 53	30

In these Table, N. signifies North, and S. South Declination. The Signs + and —, denote that the equation of time must be added to, or subtracted from, the time shewn by a sun dial, or apparent time, in order to obtain the mean time, or the time shewn by a well-regulated clock or watch.

Dialling Tables.

TABLE,

Shewing the Sun's Place and Declination, and the Equation of Time for every Day of the Year, calculated for the second Year after Leap Year.

Dialling Tables.

May.

Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♉ 10° 21′	14° 57′N	3′ 2″—	1
2	11 19	15 15	3 10	2
3	12 18	15 33	3 17	3
4	13 16	15 50	3 23	4
5	14 14	16 8	3 29	5
6	15 12	16 25	3 35	6
7	16 10	16 42	3 40	7
8	17 8	16 58	3 44	8
9	18 6	17 14	3 48	9
10	19 4	17 30	3 51	10
11	20 2	17 46	3 54	11
12	20 59	18 1	3 56	12
13	21 57	18 17	3 57	13
14	22 55	18 31	3 58	14
15	23 53	18 46	3 59	15
16	24 51	19 0	3 59	16
17	25 40	19 14	3 58	17
18	26 46	19 27	3 57	18
19	27 44	19 41	3 55	19
20	28 41	19 53	3 53	20
21	29 39	20 6	3 50	21
22	♊ 0 37	20 18	3 46	22
23	1 34	20 30	3 42	23
24	2 32	20 41	3 38	24
25	3 29	20 53	3 33	25
26	4 27	21 3	3 27	26
27	5 24	21 14	3 21	27
28	6 22	21 24	3 14	28
29	7 20	21 33	3 7	29
30	8 17	21 43	2 59	30
31	9 15	21 52	2 51	31

June.

Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♊ 10° 12′	22 0′N	2′ 42″—	1
2	11 10	22 8	2 34	2
3	12 7	22 16	2 24	3
4	13 4	22 24	2 14	4
5	14 2	22 31	2 4	5
6	14 59	22 37	1 54	6
7	15 57	22 43	1 43	7
8	16 54	22 49	1 32	8
9	17 51	22 55	1 21	9
10	18 49	23 0	1 10	10
11	19 46	23 4	0 58	11
12	20 43	23 9	0 46	12
13	21 40	23 12	0 34	13
14	22 38	23 16	0 22	14
15	23 35	23 19	0 9	15
16	24 32	23 21	0 3+	16
17	25 29	23 23	0 16	17
18	26 27	23 25	0 28	18
19	27 24	23 26	0 41	19
20	28 21	23 27	0 54	20
21	29 18	23 28	1 7	21
22	♋ 0 16	23 28	1 20	22
23	1 13	23 28	1 33	23
24	2 10	23 27	1 46	24
25	3 7	23 26	1 59	25
26	4 5	23 24	2 11	26
27	5 2	23 22	2 24	27
28	5 59	23 20	2 37	28
29	6 56	23 17	2 49	29
30	7 53	23 14	3 1	30

In these Tables, N. signifies North, and S. South Declination. The Signs + and —, denote that the equation of time must be added to, or subtracted from, the time shewn by a sun dial, or apparent time, in order to obtain the mean time, or the time shewn by a well-regulated clock or watch.

Dialling Tables.

TABLE,

Shewing the Sun's Place and Declination, and the Equation of Time for every Day of the Year, calculated for the Second Year after Leap Year.

Dialling Tables.

July.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♋ 8° 51′	23° 10′N	3′ 13″ +	1
2	9 48	23 6	3 25	2
3	10 45	23 2	3 36	3
4	11 42	22 57	3 48	4
5	12 40	22 52	3 58	5
6	13 37	22 46	4 9	6
7	14 34	22 40	4 19	7
8	15 31	22 34	4 29	8
9	16 28	22 27	4 38	9
10	17 26	22 20	4 47	10
11	18 23	22 12	4 56	11
12	19 20	22 4	5 4	12
13	20 17	21 56	5 11	13
14	21 14	21 47	5 18	14
15	22 12	21 38	5 25	15
16	23 9	21 29	5 31	16
17	24 6	21 19	5 37	17
18	25 3	21 9	5 42	18
19	26 1	20 58	5 47	19
20	26 58	20 47	5 51	20
21	27 55	20 36	5 54	21
22	28 52	20 24	5 57	22
23	29 50	20 13	6 0	23
24	♌ 0 47	20 0	6 2	24
25	1 44	19 48	6 3	25
26	2 42	19 35	6 4	26
27	3 39	19 22	6 5	27
28	4 37	19 8	6 4	28
29	5 34	18 54	6 3	29
30	6 31	18 40	6 2	30
31	7 29	18 25	6 0	31

August.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♌ 8° 26′	18° 10′N	5′ 57″ +	1
2	9 24	17 55	5 54	2
3	10 21	17 40	5 50	3
4	11 19	17 24	5 46	4
5	12 16	17 8	5 40	5
6	13 14	16 52	5 35	6
7	14 11	16 35	5 28	7
8	15 9	16 19	5 21	8
9	16 6	16 2	5 14	9
10	17 4	15 44	5 5	10
11	18 2	15 27	4 57	11
12	18 59	15 9	4 47	12
13	19 57	14 51	4 37	13
14	20 54	14 33	4 27	14
15	21 52	14 14	4 16	15
16	22 50	13 55	4 4	16
17	23 47	13 36	3 52	17
18	24 45	13 17	3 39	18
19	25 43	12 58	3 26	19
20	26 41	12 58	3 13	20
21	27 39	12 18	2 59	21
22	28 36	11 58	2 45	22
23	29 34	11 38	2 30	23
24	♍ 0 32	11 18	2 14	24
25	1 30	10 57	1 59	25
26	2 28	10 36	1 43	26
27	3 26	10 15	1 26	27
28	4 24	9 54	1 9	28
29	5 22	9 33	0 52	29
30	6 20	9 12	0 34	30
31	7 18	8 50	0 17	31

In these Tables, N. signifies North, and S. South Declination. The Signs + and —, denote that the equation of time must be added to, or subtracted from, the time shewn by a sun dial, or apparent time, in order to obtain the mean time, or the time shewn by a well-regulated clock or watch.

Dialling Tables.

TABLE,

Shewing the Sun's Place and Declination, and the Equation of Time for every Day of the Year, calculated for the Second Year after Leap Year.

September.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♍ 8° 17′	8° 29′	0′ 2″—	1
2	9 15	8 7	0 20	2
3	10 13	7 45	0 39	3
4	11 11	7 23	0 58	4
5	12 9	7 1	1 18	5
6	13 8	6 38	1 37	6
7	14 6	6 16	1 57	7
8	15 4	5 53	2 18	8
9	16 2	5 31	2 38	9
10	17 1	5 8	2 58	10
11	17 59	4 45	3 19	11
12	18 58	4 22	3 40	12
13	19 56	3 59	4 1	13
14	20 55	3 36	4 22	14
15	21 53	3 13	4 43	15
16	22 52	2 50	5 4	16
17	23 50	2 27	5 25	17
18	24 49	2 4	5 46	18
19	25 47	1 40	6 7	19
20	26 46	1 17	6 28	20
21	27 45	0 54	6 49	21
22	28 44	0 30	7 10	22
23	29 42	0 7	7 30	23
24	♎ 0 41	0 16 S.	7 51	24
25	1 40	0 40	8 11	25
26	2 39	1 3	8 32	26
27	3 38	1 27	8 52	27
28	4 37	1 50	9 12	28
29	5 36	2 14	9 31	29
30	6 35	2 37	9 51	30

October.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♎ 7° 34′	3° 0′ S.	10′ 10″—	1
2	8 33	3 24	10 29	2
3	9 33	3 47	10 47	3
4	10 32	4 10	11 6	4
5	11 31	4 34	11 24	5
6	12 30	4 57	11 42	6
7	13 29	5 20	11 59	7
8	14 29	5 43	12 16	8
9	15 28	6 6	12 32	9
10	16 27	6 29	12 48	10
11	17 27	6 51	13 4	11
12	18 26	7 14	13 19	12
13	19 26	7 37	13 34	13
14	20 25	7 59	13 48	14
15	21 25	8 22	14 2	15
16	22 24	8 44	14 15	16
17	23 24	9 6	14 27	17
18	24 23	9 28	14 39	18
19	25 23	9 50	14 50	19
20	26 23	10 11	15 1	20
21	27 23	10 33	15 11	21
22	28 22	10 54	15 20	22
23	29 22	11 16	15 28	23
24	♏ 0 22	11 37	15 36	24
25	1 22	11 58	15 43	25
26	2 22	12 18	15 50	26
27	3 22	12 39	15 55	27
28	4 22	12 59	16 0	28
29	5 22	13 14	16 5	29
30	6 22	13 39	16 8	30
31	7 22	13 59	16 11	31

In these Tables, N. signifies North, and S. South Declination. The Signs + and —, denote that the equation of time must be added to, or subtracted from, the time shewn by a sun dial, or apparent time, in order to obtain the mean time, or the time shewn by a well-regulated clock or watch.

Dialling Tables.

TABLE,

Shewing the Sun's Place and Declination, and the Equation of Time for every Day of the Year, calculated for the second Year after Leap Year.

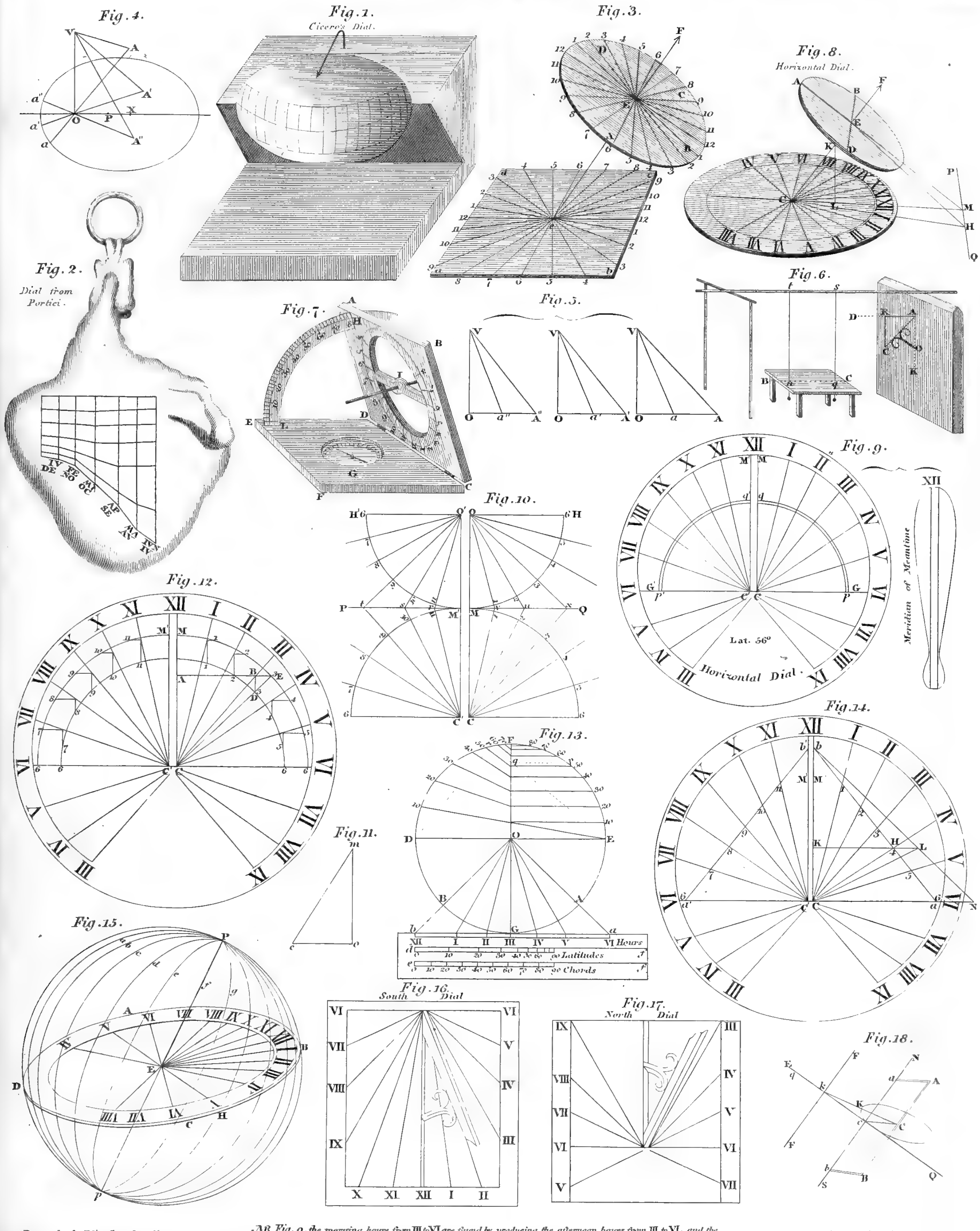
Dialling Tables.

November.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♏ 8° 22′	14° 19′S.	16′ 13″—	1
2	9 22	14 38	16 14	2
3	10 23	14 57	16 14	3
4	11 23	15 16	16 14	4
5	12 23	15 34	16 13	5
6	13 23	15 53	16 11	6
7	14 24	16 11	16 8	7
8	15 24	16 28	16 4	8
9	16 24	16 46	16 0	9
10	17 24	17 3	15 54	10
11	18 25	17 20	15 48	11
12	19 25	17 36	15 41	12
13	20 26	17 53	15 33	13
14	21 26	18 9	15 25	14
15	22 27	18 24	15 15	15
16	23 27	18 39	15 5	16
17	24 28	18 54	14 53	17
18	25 28	19 9	14 41	18
19	26 29	19 23	14 28	19
20	27 30	19 37	14 14	20
21	28 30	19 51	13 59	21
22	29 31	20 4	13 44	22
23	♐ 0 32	20 17	13 27	23
24	1 33	20 30	13 10	24
25	2 33	20 42	12 52	25
26	3 34	20 53	12 33	26
27	4 35	21 5	12 14	27
28	5 36	21 16	11 54	28
29	6 37	21 26	11 33	29
30	7 38	21 36	11 12	30

December.				
Days.	Sun's Place.	Sun's Declin.	Equation of Time.	Days.
1	♐ 8° 39′	21° 46′S.	10′ 49″—	1
2	9 39	21 55	10 27	2
3	10 40	22 4	10 3	3
4	11 41	22 13	9 39	4
5	12 42	22 21	9 15	5
6	13 43	22 28	8 50	6
7	14 44	22 35	8 24	7
8	15 45	22 42	7 58	8
9	16 46	22 48	7 31	9
10	17 47	22 54	7 4	10
11	18 48	23 0	6 37	11
12	19 49	23 5	6 9	12
13	20 50	23 9	5 41	13
14	21 51	23 13	5 13	14
15	22 52	23 16	4 44	15
16	23 53	23 19	4 15	16
17	24 55	23 22	3 45	17
18	25 56	23 24	3 16	18
19	26 57	23 26	2 46	19
20	27 58	23 27	2 16	20
21	28 59	23 28	1 46	21
22	♑ 0 0	23 28	1 16	22
23	1 2	23 28	0 45	23
24	2 3	23 27	0 15	24
25	3 4	23 26	0 15+	25
26	4 5	23 24	0 45	26
27	5 6	23 22	1 15	27
28	6 8	23 19	1 45	28
29	7 9	23 16	2 14	29
30	8 10	23 13	2 43	30
31	9 11	23 9	3 13	31

In these Tables, N. signifies North, and S. South Declination. The Signs + and —, denote that the equation of time must be added to, or subtracted from, the time shewn by a sun dial, or apparent time, in order to obtain the mean time, or the time shewn by a well-regulated clock or watch.

DIALLING. PLATE CCXXVIII.



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NB Fig. 9. the morning hours from III to VI are found by producing the afternoon hours from III to VI, and the evening hours from VI to IX by producing the morning hours from VI to IX.

Engd. by J. Moffat Edinr.

Fig. 3.
Style for Vertical E. and W. and Polar Dials.

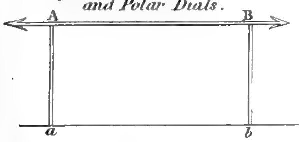


Fig. 4.
Polar Dial

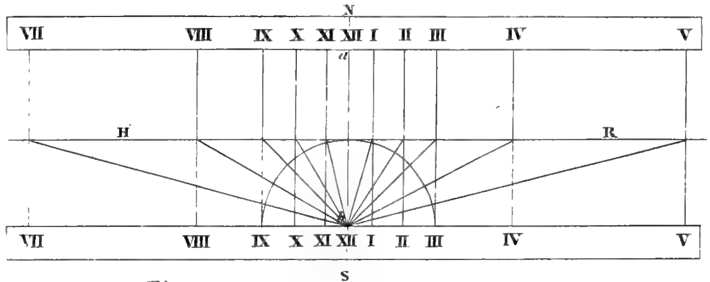


Fig. 7.
S. Dial Declinᵍ Eastward

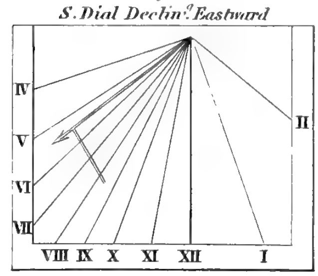


Fig. 6.
S. Dial Declinᵍ Westward

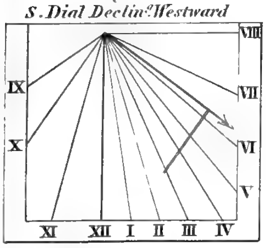


Fig. 10.

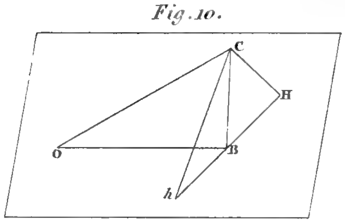


Fig. 15.

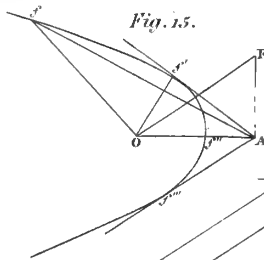


Fig. 1.
West Dial

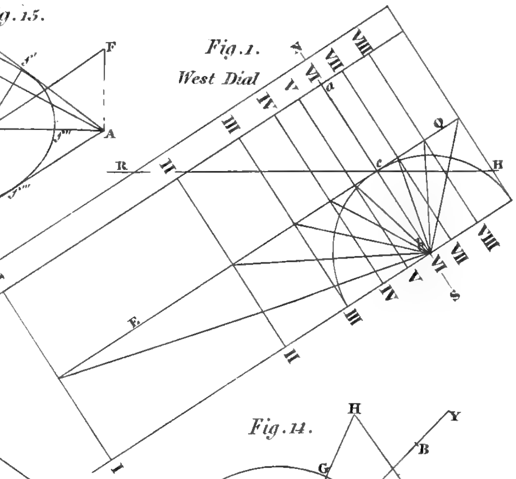


Fig. 12.
Inclining Dial

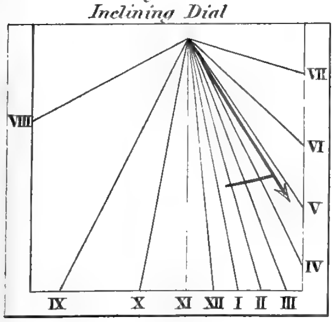


Fig. 2.
East Dial

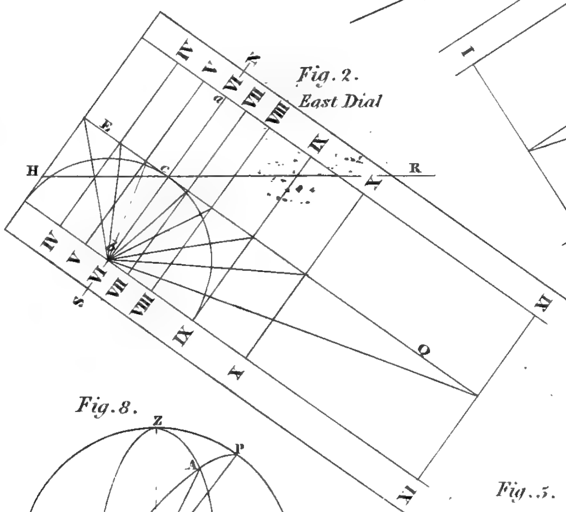


Fig. 14.

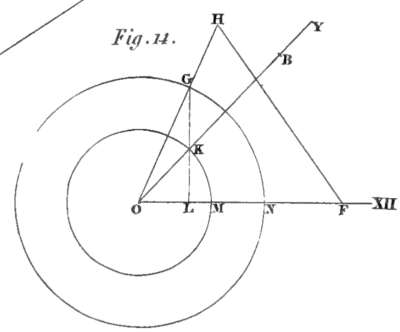


Fig. 13.

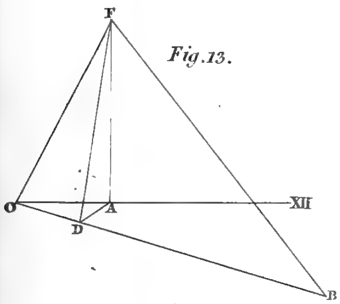


Fig. 8.

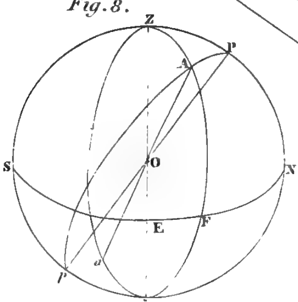


Fig. 5.
N. Pole

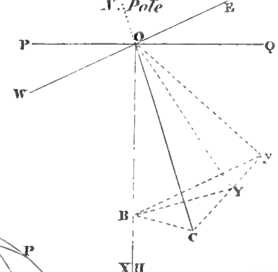


Fig. 9.

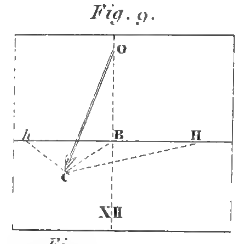


Fig. 11.

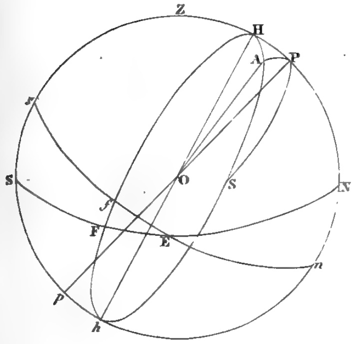


Fig. 16.

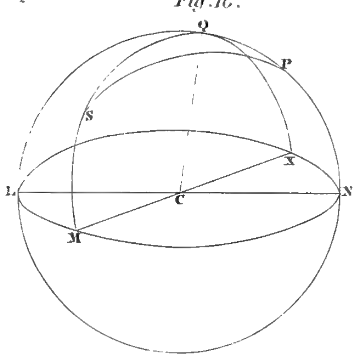
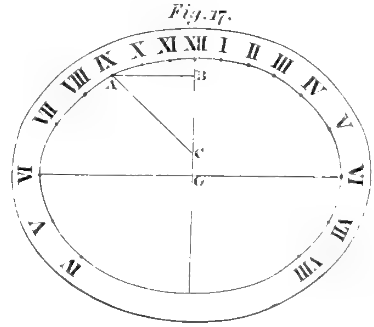
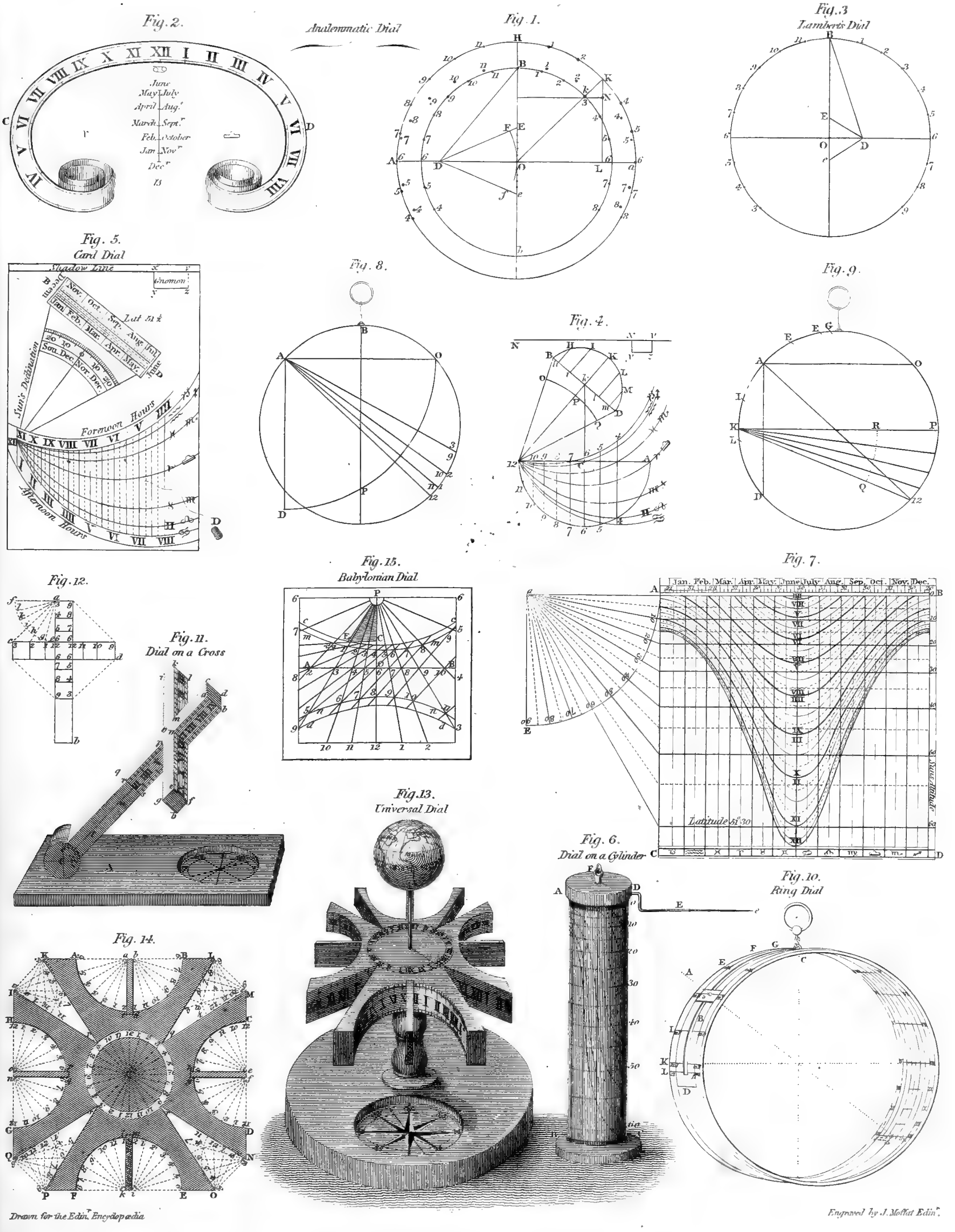


Fig. 17.





Drawn for the Edin.r Encyclopaedia

Engraved by J. Moffat Edin.r

Diamond.

DIAMOND, the most beautiful and valuable mineral substance hitherto discovered. It is the most highly prized of the gems, and, by universal consent, is placed at the head of the mineral kingdom. Its colours are various. The most frequent tints are grey and white; less frequent are the blue, red, brown, yellow, and green, and the rarest of all the varieties of colour is the dark brownish black. It occurs in roundish grains or crystals; and of these latter, the most frequent form is the octahedron or double four-sided pyramid. Its fracture is distinctly foliated with a fourfold cleavage, and the folia of the cleavages are parallel with the planes of the octahedron. Its lustre is splendent and adamantine. It is seldom completely transparent; more generally it rather inclines to semitransparent, but the black variety is nearly opaque. It refracts single. It is the hardest mineral hitherto discovered, hence it scratches all other fossils; and its specific gravity varies from 3.488 to 3.600.

External characters.

Constituent parts.

In a history of gems, published by Boetius de Boot in the year 1607, it is conjectured that the diamond is an inflammable substance. In 1673, Boyle discovered, that, when exposed to a high temperature, part of it was dissipated in acrid vapours. In 1694 and 1695, experiments were made in the presence of the Grand Duke of Tuscany, which confirmed those of Mr Boyle, and shewed that the diamond, although the hardest of minerals, agrees with combustible bodies, in being combustible. In 1704, Sir Isaac Newton, in his great work on optics, hinted, that from its very great refractive power, it might be an unctuous substance coagulated. Newton does not appear to have been acquainted with the experiments made in Tuscany; and, besides, a considerable part of his work on optics was written in 1675. Since that period, the diamond has been often examined by chemists, and they find, that, when heated to the temperature of 14° of Wedgworth's pyrometer, or not so high as the melting point of silver, it gradually dissipates and burns; and combines with nearly the same quantity of oxygen, and forms the same proportion of carbonic acid as charcoal. Hence it consists principally of carbon.*

Physical characters.

When rubbed, whether rough or polished, it shews positive electricity; whereas quartz and the other precious stones, if rough, afford negative electricity, but when polished, positive electricity. It becomes phosphorescent when exposed to the rays of the sun. Many diamonds, however, do not become phosphorescent, although agreeing in colour, form, and transparency, with these which readily become luminous. The smaller acquire this property by a much shorter exposure to the light than the larger ones; sometimes a diamond that is not phosphorescent, by the mere action of the solar rays, may be made so, by previously immersing it for some time in melted borax. See Grossier in *Journ. de Physique*, vol. xx. p. 270.

Optical properties.

Since the time of Sir Isaac Newton, the diamond has been supposed to exceed every other body in its power of refracting and reflecting light, the index of refraction, according to that philosopher, being about 2.439. Dr Brewster, however, has found, that both Chromate of lead and Realgar exceed the diamond in their action upon light. Owing to the great quantity of light which it reflects at both surfaces, the diamond is never completely transparent; and in consequence of its high refractive power, it reflects all the light that is incident upon its posterior surface at an angle of incidence exceeding 24° 13′, from which cause it derives that high lustre to which it owes its value as an ornament. The diamond has always been considered as a crystal which gives single refraction; and in whatever way it is cut, it exhibits no direct marks of two images. Dr Brewster, however, has found, that it possesses the property of depolarising light; and it necessarily follows, from his theory of depolarisation, that, like many other bodies, it actually forms two images, which are polarised in an opposite manner, like those of all doubly refracting crystals; but in consequence of its possessing only one refractive power, these images can never be separated and rendered visible. The diamond polarises light by reflection at an angle of 68° 10′ according to experiment, and at an angle of 68° 2′ according to theory; and its dispersive power is 0.038, nearly the same as oil of olives, and very much below flint glass.

Geognostic situation.

In India, they are found, in general, in alluvial soil, and in the same situation in South America. According to Mawe, the diamonds of Brazil are found in a loose gravel immediately incumbent on the solid rock, and covered by vegetable mould, and recent alluvial matter. This gravel consists principally of rounded quartzy pebbles of various sizes, mixed with sand and oxide of iron, and containing blue, yellow, and white topazes, and grains of gold. In some parts of Serra do Frio, the gravel is cemented by means of iron into a hard conglomerate. Humboldt observed diamonds imbedded in amygdaloid, in specimens, in the collection belonging to the Stadtholder, now in Paris; also in similar specimens in England; and all of them were from India.†

Geographic situation.

The diamond was first found in Asia, where it is still collected, although not in such quantity as formerly. It occurs principally in the provinces of Golconda, Visapour, Bengal, and the island of Borneo.

In America, diamonds occur only in Brazil, in the district of Serra do Frio, where they were first discovered towards the beginning of the last century.

Method of searching for diamonds.

The usual method of searching for diamonds in Brazil, is to collect the disintegrated conglomerate, in which they are found, at the bottoms of rivers and of ravines, and by a laborious process of washing as long as the water comes off discoloured, to separate the mud from the distinct grains. The residue thus cleaned, is carefully examined for the diamonds which it may contain. These are distinguished partly by their crystalline form, but principally by their adamantine lustre. Diamonds of the smallest size, that is, whose weight does not exceed a fifth of a carat, or even the fifth of a grain, are by far the most abundant; these are of no use in jewellery, but when broken and ground to the requisite degree of fineness, form what is called *diamond powder*; a material used for cutting and polishing the diamond and other hard gems.

In some districts in India, diamonds are found loose in the narrow crevices of rocks: the miners make use of long iron rods, with hooks at the ends, and with these they draw out the loose contents of the fissures, and wash them in tubs, in order to discover the diamonds. In Colour, in Golconda, they dig in a large plain to the depth of ten or fourteen feet, and the earth is carried to the washing places by women and children.‡

* It was Sir George Mackenzie who first accurately determined the temperature at which diamond begins to burn. See Nicholson's *Journal*, vol. v. p. 104.

† Dr Thomson, in his *Annals of Philosophy*, mentions specimens of amygdaloid containing diamond, from India.

‡ At one period, nearly sixty thousand people were employed in searching for diamonds in Colour.

The celebrated traveller, Tavernier, who visited these mines, gives the following account of the process.

"After the miners have pitched upon the place where they intend to work, they level another place close by, of the same extent, or else a little bigger, which they enclose with a wall about two feet high; in the bottom of that little wall, at the distance of every two feet, they make small holes to let in the water, which they stop up afterwards, till they come to drain out the water again. This done, their labours are preceded by acts of devotion, and a very simple feast. When that is over, the men fall to digging, the women and children to carry the earth to the place prepared in that manner, as I have already described: they dig ten, twelve, and sometimes fourteen feet deep; but when they come to any water, they leave off. All the earth being carried into the place before mentioned, the men, women, and children, with pitchers, throw the water which is in the drain upon the earth, letting it soak for two or three days, according to the hardness of it, till it come to be a kind of batter, then they open the holes in the wall to let out the water, and throw on more water until all the mud is washed away, and nothing left but the sand; after that they dry it in the sun, and then they winnow the sand in little winnows as we winnow our corn. The small dust flies away, the great remains, which they pour out again upon the ground.

The earth being thus winnowed, they spread it with a kind of rake as thin as they possibly can, then with a wooden instrument like a pavier's rammer, about half a foot wide at the bottom, they pound the earth from one end to the other two or three times over; after that they winnow it again, and spreading it at one end of the van, for fear of losing any of the earth, they then look for the diamonds."

Diamonds are also collected from the gravel or sand of rivers. The river Gouel, near Soumelpour, in the province of Bengal, in the time of Tavernier, was said to be noted in this respect, and is the most ancient diamond district in the East. In the island of Borneo, diamonds are collected from the gravel and sand of the river Succadan.

Art of cutting and polishing diamonds.

The ancients were unacquainted with the art of cutting the diamond; and hence they used it in its natural, granular, or crystallised state. Even in the middle ages, this art remained still unknown; for the four large diamonds that ornament the clasp of the imperial mantle of Charlemagne, and which is still preserved in Paris, are uncut octahedral crystals.

The art of cutting and polishing diamonds was probably known to the artists of Hindostan and China at a very early period. European artists, until the fifteenth century, were of opinion that it was impossible to cut the diamond. Robert de Berghen, in the year 1456, endeavoured to polish two diamonds, by rubbing them against each other. He found, that, by this means, a facet was produced on the surface of the diamonds; and, in consequence of this hint, constructed a polishing wheel, on which, by means of diamond powder, he was enabled to cut and polish this substance in the same way as other gems are wrought by emery. This art has been gradually improved, particularly by the Dutch and British jewellers. For a long time all the finest diamonds were sent to Holland to be cut and polished, owing to the real or fancied superiority of the Dutch artists. Now the diamond cutters in London are considered as equal to any in the world; and we no longer hear of this gem being sent abroad to be cut by foreign artists, on account of any want of skill in our workmen.

The cutting and polishing of the diamond is effected in the following manner: If the rough diamond has rents or flaws which must be removed, or if the figure is such that it must be altered before it is regularly cut, we either split or saw off the part or parts. The splitting is effected by the blow of a hammer on a small chissel, placed in the direction of the folia or cleavage of the diamond. The sawing is effected by means of an iron wire attached to a bow; the wire is covered with diamond powder, and drawn backwards and forwords, until the portion is cut off. This, however, is a very tedious process, as the wire is generally cut through after having been drawn across the diamond five or six times, and thus requires very frequent renewal. When the diamond is in this way freed from its flaws, and reduced to the proper shape, it is next imbedded in a strong cement of brick dust and white pitch, fixed at the end of a spindle-shaped stick about a foot long, with that portion only projecting, the removal of which is to form the facet. The facet is formed by the friction of another diamond fixed in a stick in a similar manner to the former, with one of the angles projecting. In order to collect the powder and splinters that are detached during the process, the cutting is performed over a strong box, four or five inches square, furnished with a false bottom, perforated with excessively minute holes, in order to sift as it were the dust from the splinters; and also with two upright iron pegs fixed on the sides for the workmen to support and steady his fingers against, while, with a sharp repeated stroke, somewhat between scratching and cutting, he is wearing away the diamond on that part where the facet is to be made. This being done, the cement is softened by warming it, and the position of the diamond is changed, in order to bring a fresh part under the action of the cutting diamond. When, in this manner, all the facets have been cut upon the surface of the diamond, the cutting is completed. The next object is to polish the facets, and, at the same time, to remove any little inequalities that may have taken place in the cutting. The polishing mill is very simple. It consists of a circular horizontal plate of cast iron, 14 or 15 inches in diameter, (called a *skive*) suspended on a spindle, and put in motion by means of a wheel 5 or 6 feet in diameter, and turned by an assistant. From the centre to the circumference of the iron plate, are shallow grooves, formed by rubbing it in that direction with a fine grained sandstone; these grooves serve to retain the mixture of oil and diamond powder with which the plate is charged. In order to keep the diamond perfectly steady while the polishing of each facet is going on, the following contrivance is had recourse to. A copper cup, about three quarters of an inch in depth and width, and furnished with a stem about four inches long of thick copper wire, is filled with plumbers' solder, which also projects in a conical form beyond the rim of the cup; in the apex of this cone, the solder being softened by heat, the diamond is imbedded with one of the facets projecting. The stem of the cup is now put into very powerful pincers, which screw up with a nut and a wrench, and thus hold it perfectly tight. The handles of the pincers are of wood, are broad, and terminated by two feet about an inch high. In this position the diamond is placed on the plate, the pincers resting on their legs on the wood-

Diamond. en bench or table that supports the plate, and pressing at the same time against an upright iron peg; the broad part of the pincers between the legs and the diamond is then loaded with weights, both to steady the machine and to increase the pressure of the diamond against the skive. A little oil and diamond powder is now dropped on the plate; it is set in motion at the rate of about 200 revolutions in a minute, and the grinding and polishing processes now begin. The diamond is examined from time to time, and is adjusted so as to give the facet its true form. The heat occasioned by the friction is at all times considerable, and sometimes increases to such a degree as to soften the solder, and displace the diamond. This accident sometimes occasions a flaw in the diamond, and always damages the skive, by tearing up its surface. There is room in the skive for three or four diamonds, and a skilful operator can undertake the polishing of all of them at the same time. The completion of a single facet often occupies some hours.

Different forms into which they are cut.

Diamonds are cut and manufactured by jewellers into *brilliant, rose,* and *table* diamonds. To fashion a rough diamond into a brilliant, the first step is to modify the faces of the original octahedron, so that the plane formed by the junction of the two pyramids shall be an exact square, and the axis of the crystal precisely twice the length of one of the sides of the square. The octahedron being thus rectified, a section is to be made parallel to the common base, or girdle, so as to cut off $\frac{5}{18}$ths of the whole height from the upper pyramid, and $\frac{1}{18}$th from the lower. The superior and larger plane thus produced, is called the *table*, and the inferior and smaller one is named the *collet*; in this state it is called a *complete square table diamond.* To convert it into a brilliant, two triangular facets are placed on each side of the table, thus changing it from a square into an octagon; a lozenge-shaped facet is also placed at each of the four corners of the table, and another lozenge extending lengthwise along the whole of each side of the original square of the table, which, with two triangular facets, set on the base of each lozenge, complete the whole number of facets on the table side of the diamond, viz. eight lozenges, and twenty-four triangles. On the collet side are formed four irregular pentagons, alternating with as many irregular lozenges, radiating from the collet as a centre, and bordered by 16 triangular facets adjoining to the girdle. The brilliant being thus completed, is set with the table side upwards, and the collet side implanted in the cavity made to receive the diamond. Such is the method recommended by Mr Jeffries for cutting the brilliant diamond, and which ought to be attended to, if we are desirous that the diamond should display its highest degree of lustre and play of colour; but Mr Mawe remarks, "that so great a stress is laid by modern fashion on the superficial extent of a brilliant, that the rules just given are not much attended to; and, in forming the facets, artists trust principally to an accurate and well practised eye.*

The *regular rose diamond* is that form given to those stones, the spread of which is too great in proportion to their depth, to admit of being brilliant cut, without a great loss of substance. It is formed by inscribing a regular octagon in the centre of the table side of the stone, and bordering it by eight right angled triangles, the bases of which correspond with the sides of the octagon; beyond these is a chain of eight trapeziums, and another of sixteen triangles. The collet side also consists of a minute central octagon, from every angle of which proceeds a ray to the edge of the girdle, forming the whole surface into eight trapeziums, each of which is again subdivided by a salient angle (the apex of which touches the girdle,) into one irregular pentagon, and two triangles. † Diamond.

The *table diamond* is the least beautiful mode of cutting, and is used only for those stones, or rather fragments, which, with a considerable breadth, have only a very trifling depth.

Valuing diamonds.

In valuing diamonds, we have to attend to their *weight*, their *form* when cut, *colour, transparency, purity, or freedom from flaws, veins and stains*, the *regularity of the cleavage, proportion of the parts, and lastly, the setting on of the facets.*

1. Weight and form.

In the cutting either of a brilliant or a rose diamond, of regular proportions, so much is cut away, that the weight of the polished gem is not more than half that of the rough crystal out of which it was formed; whence the value of a cut diamond is esteemed equal to that of a similar rough diamond of twice its weight, exclusive of the cost of workmanship. The weight, and consequently the value, of diamonds, is estimated in *carats*, one of which is equal to four grains, and the difference between the price of one diamond and another, *cæteris paribus*, is as the square of the respective weights. Thus the value of three diamonds, of one, two, and three carats weight, is as one, four, and nine. The average price of rough diamonds, that are worth working, is about L. 2 for the first carat; and consequently in wrought diamonds, exclusive of the cost of workmanship, the cost of the first carat is L. 8. In other words, in order to ascertain the value of a wrought diamond, ascertain its weight in carats, and fractions of a carat, multiply this by two, then multiply this product into itself, and finally multiply this latter sum by L. 2. Hence a wrought diamond of

1	carat is worth	L.8
2	....	32
3	....	72
4	....	128
5	....	200
6	....	288
7	....	392
8	....	512
9	....	612
10	....	800
20	....	3,200
30	....	7,200
40	....	12,000
50	....	20,000
60	....	28,800
70	....	39,200
80	....	51,200
90	....	64,800
100	....	80,000

This rule, however, actually holds good only in the smaller diamonds of 20 carats and under; the larger ones, in consequence of the scarcity of purchasers, being disposed of at prices greatly inferior to their estimated worth. The value of some of the most perfect

* The brilliant form was invented in England.

† The finest rose cut diamonds were formerly manufactured in Holland. More than 300 years ago, this mode of cutting was known and practised at Antwerp.

Diamond. diamonds exceeds that given in the table; but for a stone that is flawed, cloudy, or of a bad colour, sometimes three quarters of the whole value may be deducted.

2. Colour. The most frequent colours of the diamond, as already mentioned, are the white and grey, and of these the most highly prized by the jeweller is the snow white. The brown varieties are of inferior value, and the yellow diamond, which is not uncommon, is only esteemed of equal value with the snow white variety when the colour is deep and pure. The other varieties of colour occur but rarely, and are viewed as objects of curiosity to the collector rather than as generally interesting to the jeweller. Thus a rose diamond is more valuable than a snow white diamond of equal weight, owing to the great beauty of its colour, and its rarity; the green diamond is much esteemed on account of its colour, but the blue diamond is only prized for its rarity, as the colour is seldom pure. The black diamond, which is uncommonly rare, and destitute of beauty, is very highly prized by collectors. *

3. Transparency. A good diamond must be nearly completely transparent. If semitransparent, it is of little value. Transparency and purity comprehend what is called the *water* of the diamond by jewellers. If the gem is transparent and quite pure, it is said to be of the first water; if less transparent and pure, of the second, or of the third water.

4. Freedom from flaws, veins, and stains. Diamonds in a state of nature are sometimes rent in different directions; these rents are either confined to the surface or central parts of the stone, or traverse its whole mass. When the rents traverse the whole mass of the stone, or traverse its interior, the value of the diamond is diminished one half. If the rents are superficial, the value of the stone is not very greatly diminished. It requires a very experienced eye to distinguish these different kinds of rents.

Rough diamonds are frequently *beamy*, that is, look fair to the eye, yet are so full of veins to the centre that no art or labour can polish them. Mr Milburn, in his valuable work on *Oriental Commerce*, vol. ii. p. 80, gives the following account of *beamy* diamonds. "The veins run through several parts of the stone, and sometimes through all; and when they appear on the outside, they shew themselves like protuberant excrescences, from whence run innumerable small veins, obliquely crossing one another, and shooting into the body of the stone. The stone itself will have a bright and shining coat, and the veins will look like very small veins of polished steel rising upon the surface of the stone. This sort of stone will bear no polishing, and is scarcely worth a rupee per mangalin. Sometimes the knot of the veins will be in the centre, the fibres will shoot outward, and the small ends terminate in the coat of the diamond. This is more difficult to discover, and must be examined by a nice eye; yet you may be able here and there to observe a small protuberance, like the point of a needle, lifting up a part of the coat of the stone; and though by a great deal of labour it should be polished, it will be a great charge, and scarcely pay for the cutting, and is therefore to be esteemed as little better than the former. But if you are not very careful, they will throw one of these stones into a parcel, and oftentimes the largest."

A good diamond should never contain small spots of a white or grey colour of a nebulous form; it should be free of small reddish and brownish grains, that sometimes occur on their surface, or in their interior.

5. Regularity of the cleavage. A good diamond should split readily in the direction of the cleavage; it sometimes happens, however, that the folia are curved, as is the case in twin crystals. When this is the case, the stone does not readily cut and polish, and is therefore of inferior value.

6. Proportion of parts. In the cut and polished gem, the thickness must always bear a certain proportion to the breadth. It must not be too thin nor too thick; when too thin it loses much of its fire, and appears not unlike glass.

7. The setting on of the facets. If these are not properly disposed, the diamond loses much of its fire, and its value is thereby diminished.

Diamond trade. The only diamond districts at present known, are those of India, Borneo, and Brazil. In the earlier ages, all the diamonds of commerce were obtained from India, but now the diamond mines of that country have become comparatively inconsiderable; several of them have been abandoned, and scarcely any of the rest contribute to the supply of the European market. Borneo furnishes annually a small quantity. The diamonds of the East are imported into Europe in their rough state, in small parcels, called *bulses*, neatly secured in linen, and sealed by the merchant, and are generally sold in Europe by the invoice, that is, are bought before they are opened, it being always found they contain the value for which they were sold in India, and the purchaser gives the importer such an advance on the invoice as the state of the market warrants. The bulse contains stones of various shapes and sizes. They may

* Mr Milburn has the following observations on the colour of rough diamonds, which are deserving the attention of the diamond merchant. "The colour should be perfectly crystalline, resembling a drop of clear spring water, in the middle of which you will perceive a strong light, playing with a great deal of spirit. If the coat be smooth and bright, with a little tincture of green in it, it is not the worse, and seldom proves bad; but if there is a mixture of yellow with green, then beware of it,—it is a soft greasy stone, and will prove bad.

If the stone has a rough coat, so that you can hardly see through it, and the coat be white and look as if it were rough by art, and clear of flaws or veins, and no blemish cast in the body of the stone (which may be discovered by holding it against the light,) the stone will prove good.

It often happens, that a stone will appear of a reddish hue on the outward coat, not unlike the colour of rusty iron; yet by looking through it against the light, you may observe the heart of the stone to be white, (and if there be any black spots or flaws, or veins in it, they may be discovered by a true eye, although the coat of the stone be the same,) and such stones are generally good and clear.

If a diamond appears of a greenish bright coat, resembling a piece of green glass, inclining to black, it generally proves hard, and seldom bad; such stones have been known to have been of the first water, and seldom worse than the second; but if any tincture of yellow seem to be mixed with it, you may depend upon its being a very bad stone.

All stones of a milky coat, whether the coat be bright or dull, if never so little inclining to a bluish cast, are naturally soft, and in danger of being flawed in the cutting; and though they should have the good fortune to escape, yet they will prove dead and milky, and turn to no account.

All diamonds of cinnamon colour are dubious; but if of a bright coat, mixed with a little green, then they are certainly bad, and are accounted amongst the worst of colours.

You will meet with a great many diamonds of a rough cinnamon coloured coat, opaque, ; this sort is generally very hard, and when cut, contains a great deal of life and spirit; but the colour is very uncertain; it is sometimes white, sometimes brown, and sometimes of a fine yellow."

be imported duty free, saving the duty granted to the East India Company on diamonds imported from any place within the limits of their charter.

Brazil affords more diamonds than India and Borneo, and it is said that nearly all the diamonds in the European market are obtained from that country. The diamond mines of Brazil belong either to the crown or to the Prince Regent. The trade in this gem, except through the medium of the government agents, is considered as contraband. Notwithstanding the severe penalties against this contraband trade, many diamonds are disposed of by private adventurers. The government diamonds, however, form the chief part of the trade. These are the produce of the different royal mines in the interior of Brazil; whence they are sent to the seat of government at Rio de Janeiro. The Prince Regent there selects from the whole such specimens as he chooses to add to his own magnificent collection, and the remainder are consigned to the Portuguese ambassador for the time resident in England, by whom they are deposited in the Bank for sale.

This branch of trade was, at one period, almost monopolized by the Dutch. The consul for Holland possessed an exclusive contract in Brazil for all the diamonds that were brought to the market in that country, whilst in India their agents were very active in securing all that were offered for sale. The trade is now divided between the English and Portuguese. The demand for diamonds of a moderate size is, at present, very great; and it would appear that the price of this gem has been gradually rising for several years. The sale of the larger diamonds has been very dull for many years past.

Uses.

The principal use of the diamond is in jewellery. It is also used by lapidaries for cutting and engraving upon harder gems, by watchmakers in their finer kinds of work; and by glaziers for cutting glass.

Account of some large diamonds.

We shall conclude our history of the diamond, with a short account of some of the largest diamonds hitherto discovered.

1. Authors mention a diamond weighing 1680 carats in the possession of the royal family of Portugal, which was found in Brazil, and is still uncut. This gem, if valued according to the rule already mentioned, should be worth L.5,644,800 sterling. It is now, however, generally believed, to be a fine white-coloured topaz.

2. The largest undoubted diamond, is that mentioned by Tavernier, which was in the possession of the Great Mogul, and which that traveller found to weigh $279\frac{9}{16}$ carats. It is the size of a hen's egg, of the same shape, and is cut in the rose form. Before cutting it weighed 900 carats. It was found in the mine of Colore, to the east of Golconda, about the year 1550.

3. The magnificent diamond on the top of the sceptre of the Emperor of Russia, deserves next to be noticed. It is perfectly pure; weighs 195 carats; and is the size of a pigeon's egg. It was one of the eyes of a Brahminical idol, and was stolen by a French grenadier, who disposed of it at a very low price; and lastly, after passing through three other hands, it was offered for sale to the Empress Catharine of Russia, who purchased it for about L.90,000 ready money, and an annuity of about L.4000 more.

4. The diamond of the late Grand Duke of Tuscany, now in Vienna, is of a pale lemon yellow colour, but beautifully formed, and weighs $139\frac{1}{2}$ carats.

5. The Pit or Regent diamond. It is cut in the brilliant form, and is said to be the most beautiful diamond hitherto found. It weighs $136\frac{1}{4}$ carats, and was purchased for L.130,000, although it is now valued at double that sum. It was brought from India by an English gentleman of the name of Pit, and was sold by him to the Regent Duke of Orleans, by whom it was placed among the crown jewels of France. It is now set in the handle of the sword of state of Bonaparte.

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DIANA, in the ancient mythology, was the daughter of Jupiter and Latona, and the twin-sister of Apollo. Several characters are assigned to her by the classical writers; and she is clothed with various symbolical appendages, indicative of her different attributes: the goddess of the woods and of hunting upon earth; *Luna,* or the moon, in heaven; and *Hecate,* or the power presiding over witchcraft in the infernal regions.

The *Diana venatrix,* or goddess of the chace, is frequently represented in ancient sculpture; and she is described by the Roman poets, as running, with her vest shortened and girt up about her, yet flying back with the wind; she is tall of stature, and her countenance, though handsome, is somewhat masculine; her legs are naked, well-formed and strong; her feet are sometimes bare, and sometimes adorned with a species of buskin; she has often a quiver on her shoulder, and sometimes holds a javelin, but more commonly a bow, in her right hand.

When Diana is represented as presiding over the moon, she appears in a car drawn by stags or does, but more frequently by horses of a pure white colour, with a lunar crown or crescent upon her forehead. In this character she was invoked by women in childbed, under the appellation of *Juno Lucina,* or *Pronuba.*

The infernal Diana was distinguished by the name of *Hecate* or *Trivia*; in which character she was invoked in enchantments, and represented as a fury, holding instruments of terror in her hands, and grasping cords, swords, serpents, or burning torches. The appellation of *trivia,* or *triformis,* appears to have been derived from the custom of representing her sometimes with three bodies, or three heads.

Diana was known under several other names, most of which appear to have originated from the different places where she was worshipped; but she is easily distinguished in the figures which represent her, either by the crescent upon her head, or by her bow and arrows, or by her hunting dress, or by the dogs that accompany her. Among the Greeks, she was considered as the goddess of chastity, and hence virgins were given her for companions; yet she is represented, in the ancient fables, as by no means averse from gallantry; and is said to have bestowed her favours on Endymion, Pan, and Priapus. The Greeks appear to have derived their mythological system, in a great measure, from the Egyptians; and Diana, the sister of Apollo, is generally held to be the same with Isis, the sister of Osiris.

Diana had many oracles in ancient times; and many temples were dedicated to her worship. Of these latter, the most celebrated was that at Ephesus, which, on account of its size, structure, and embellishments, was esteemed one of the seven wonders of the world. Some account of the construction of this famous temple has been transmitted to us by two ancient authors, Vitruvius and Pliny. The former tells us, that it had eight columns in the fore-front, and as many in the back-front; that it had a double range of columns round it; and that it was of the Ionic order. Pliny states, (lib. xxxvi. cap. 14.) that two hundred and twenty years elapsed during its construction; that it was 425 feet in length, and 220 in breadth; that it was adorned with 100 columns, each 60 feet high, &c. Of these columns, 27 were very curiously carved, and the rest polished. The architect employed in executing this edifice was Ctesiphon, or Ctesifonte; and the bas-reliefs of one of the columns were done by Scopas, the most celebrated sculptor of antiquity. The altar was adorned with the masterly performances of the famous Praxiteles. The "great Diana of the Ephesians" was, according to Pliny, a small statue of ebony, made by one Canitia, though believed by the vulgar to have been sent down from heaven by Jupiter. The temple was several times destroyed and rebuilt, until it was finally burnt by the Goths, in the year 260.

It would appear from some reliques, that the worship of Diana had prevailed, in ancient times, both in Gaul and in Britain; and Mr Camden thinks it not improbable, that there was anciently a temple of Diana, where St Paul's Cathedral now stands, from the great number of ox heads which were found there in digging up the church-yard, in the reign of Edward I. An ancient MS. in the Cotton library informs us, that in the time of Melitus, the first bishop of London, Ethelbert, king of Kent, built a church in honour of St Paul, on the site where a temple of Diana previously stood; and certain ceremonies continued to be performed by the multitude, as far down as the days of Queen Elizabeth, on the day of St Paul's conversion, which obviously alluded to the worship of Diana. (*z*)

DIANDRIA. See BOTANY, p. 73, 75, and 85.

DIANELLA, a genus of plants of the class Hexandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl.* &c. p. 279, 280; and BOTANY, p. 194.

DIANTHUS, a genus of plants of the class Decandria, and order Digynia. See BOTANY, p. 216.

DIAPASON, in Music, an interval so called by the ancient writers, who supposed it to be full or complete, and contain all other intervals; its ratio is $\frac{1}{2}$, $= 612\Sigma + 12f + 53m$; the octave VIIIth, or *Major* EIGHTH, which see. (*ρ*)

DIAPASON DIAEX, the *greater,* an interval whose ratio is $\frac{3}{10} = 1063\Sigma + 21f + 92m$; the THIRTEENTH *Minor,* (or 13th,) which see.

DIAPASON DIAEX, the *lesser,* an interval whose ratio is $\frac{5}{16} = 1027\Sigma + 20f + 89m$; the THIRTEENTH *Major,* or XIII. which see.

DIAPASON DIAPENTE, an interval whose ratio is $\frac{1}{3}$, $= 970\Sigma + 19f + 84m$; the TWELFTH *Major,* (or XII.) which see. This interval was supposed by Mr Hoyle to be equal to nine tones and a semitone; and by M. Capella, to be equal to eight tones and a semitone, the fallacy of which will, however, appear from the following equations, in the characters used in Plate XXX. Vol. II. viz. $XII + 2\Sigma = 9T + \mathcal{S}$, $XII + 2\Sigma = 8T + t + \mathbb{S}$, $XII + \Sigma = 7T + 2t + S$, and $XII + \Sigma = 6T + 3t + \mathbb{S}$. The same writer also maintained this interval, the XII. to be equal to 19 semitones, and 38 diesis. See DIESIS *greater,* of M. Capella.

DIAPASON DIATESSERON, an interval whose ratio is $\frac{3}{8} = 866\Sigma + 17f + 75m$; the ELEVENTH *Minor,* (or 11th,) which see. M. Capella supposed this interval to be equal to eight tones and a semitone, but which is not correctly so, for $11\text{th} + 2\Sigma = 8T + \mathcal{S}$, $11\text{th} + 2\Sigma = 7T + t + \mathbb{S}$, $11\text{th} + \Sigma = 6T + 2t + S$, and $11\text{th} + \Sigma = 5T + 3t + \mathbb{S}$. M. Capella also says, that the 11th is equal to 17 semitones and 34 dieses. See DIESES *lesser*, of M. Capella.

DIAPASON DITONE, an interval whose ratio is $\frac{2}{5}$, $= 890\Sigma + 16f + 70m$; the TENTH *Major*, (or Xth,) which see.

DIAPASON IMPERFECT, an interval whose ratio is $\frac{25}{48}$, $= 576\Sigma + 11f + 50m$; the EIGHTH *Acute Minor*, (or 8th of Liston,) which see.

DIAPASON, SEMIDITONE, an interval whose ratio is $\frac{5}{12}$, $= 773\Sigma + 15f + 67m$; the TENTH *Minor*, (or 10th,) which see.

DIAPASON, SUPERFLUOUS, an interval whose ratio is $\frac{12}{25}$, $= 648\Sigma + 13f + 56m$; the EIGHTH *Superfluous*, which see.

DIAPASON STOPS, in Music, are ranges of pipes through the scale of an organ, which are considered as the standard of pitch, and are usually first tuned; after the pitch of C, in the middle octave, answering to the tenor cliff or ledger-line above the bass or below the treble staves, has been adjusted, by means of a standard pipe, or by some of the methods described under our article CONCERT *Pitch*. The diapasons are of two kinds; the *open* diapason stop, which is a range of cylindrical pewter pipes, some of which are commonly gilt, and exhibited in the front of the instrument; and the *stopt* diapason stop, a range of square wooden pipes, with plugs or stoppers in their upper ends, which are drawn out or shoved in, to effect the tuning. In order to yield the same notes, these stopt wooden pipes are only about half the length or height of the open metal ones. See ORGAN. (ρ)

DIAPENSIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 140.

DIAPENTE, in Music, or *Pentachord*, is an interval whose ratio is $\frac{2}{3}$, $= 358\Sigma + 7f + 31m$; the FIFTH *Major*, (or Vth,) which see. (ρ)

DIAPHANOMETER, from διαφανεια, *transparency*, and μετρον, a *measure*, is the name of an instrument invented by Saussure, for measuring the transparency of a portion of the atmosphere.

The Cyanometer, which we have already described under its proper head, by ascertaining the intensity of the blue colour of the sky, enables us to measure the total effect of the vapour and evaporation diffused through the whole depth of the atmosphere; whereas the Diaphanometer, by measuring the transparency of a portion of the atmosphere of limited extent, is intended to shew the quantity of vapour or evaporation existing in that portion.

The distances at which the same object ceases to be visible in different states of the atmosphere, are obviously relative measures of the transparencies of the portion of the atmosphere, between the object and the observer, at the times when the observations were made; and hence it was Saussure's first difficulty to find objects, the disappearance of which could, at a certain distance, be ascertained with the utmost accuracy. He found that the extent of disappearance could be more accurately perceived when a black object was placed upon a white ground, than when a white object was placed upon a black ground; that the results were still more precise, when the disappearance was observed in sunshine, than when it was observed in the shade; and that they were still more correct, when the white shade, surrounding a black circle, was itself encircled by a ground of a darker hue.

The following account of Saussure's experiments, by Dr F. W. Murhard, of Gottingen, is so short and perspicuous, that it will not admit of abridgment.

Saussure's Diaphanometer.

"If a circle totally black, of about two lines in diameter, be fastened on the middle of a large sheet of paper or pasteboard, and if this paper or pasteboard be placed in such a manner as to be exposed fully to the light or the sun, if you then approach it at the distance of three or four feet, and afterwards gradually recede from it, keeping your eye constantly directed towards the black circle, it will appear always to decrease in size the farther you retire from it, and at the distance of 33 or 34 feet will have the appearance of a point. If you continue still to recede, you will see it again enlarge itself; and it will seem to form a kind of cloud, the darkness of which decreases more and more, according as the circumference becomes enlarged. The cloud will appear still to increase in size, the farther you remove from it; but at length it will totally disappear. The moment of the disappearance, however, cannot be accurately ascertained; and the more experiments were repeated, the more were the results different. This is an observation perfectly accurate; and having myself made a series of experiments under like circumstances, I am the more convinced of the truth of it.

M. de Saussure having reflected for a long time on the means of remedying this inconveniency, saw clearly, that, as long as this cloud took place, no accuracy could be obtained; and he discovered that it appeared in consequence of the contrast formed by the white parts, which were at the greatest distance from the black circle. He thence concluded, that if the ground was left white near this circle, and the parts of the pasteboard at the greatest distance from it were covered with a dark colour, the cloud would no longer be visible, or at least would almost totally disappear.

This conjecture was confirmed by experiment. M. de Saussure left a white space round the black circle, equal in breadth to its diameter, by placing a circle of black paper, a line in diameter, on the middle of a white circle three lines in diameter, so that the black circle was only surrounded by a white ring, a line in breadth. The whole was pasted upon a green ground. A green colour was chosen, because it was dark enough to make the cloud disappear, and the easiest to be procured.

The black circle, surrounded in this manner, with white on a green ground, disappeared at a much less distance, than when it was on a white ground of a large size.

If a perfectly black circle, a line in diameter, be pasted on the middle of a white ground exposed to the open light, I can observe it at the distance of from 44 to 45 feet; but if this circle be surrounded by a white ring, a line in breadth, while the rest of the ground is green, I lose sight of it at the distance of only $15\frac{1}{2}$ feet.

According to these principles, M. de Saussure delineated several black circles, the diameters of which increased in a geometrical progression, the exponent of which was $\frac{3}{2}$. His smallest circle was $\frac{1}{5}$ or 0.2 of a line in diameter; the second, 0.3; the third, 0.45; and so on to the sixteenth, which was 87.527, or about 7 inches $3\frac{1}{2}$ lines. Each of these circles was surrounded by a white ring, the breadth of which was equal to the diameter of the circle, and the whole was pasted on a green ground.

Diaphanometer.

M. de Saussure selected, for his experiments, a straight road or plain of about 12 or 1500 feet in circumference, which towards the north was bounded by trees or an ascent. Those who repeat them, however, must pay attention to the following remarks:—When a person retires backwards, keeping his eye constantly fixed on the pasteboard, the eye becomes fatigued, and soon ceases to perceive the circle; as soon, therefore, as it ceases to be distinguishable, you must suffer your eyes to rest; not, however, by shutting them, for they would when again opened be dazzled by the light, but by turning them gradually to some less illuminated object in the horizon. When you have done this for about half a minute, and again directed your eyes to the pasteboard, the circle will be again visible, and you must continue to recede till it disappear once more. You must then let your eyes rest a second time, in order to look at the circle again, and continue in this manner till the circle becomes actually invisible.

If you wish to find an accurate expression for the want of transparency, you must employ a number of circles, the diameters of which increase according to a certain progression; and a comparison of the distances at which they disappear, will give the law according to which the transparency of the atmosphere decreases at different distances. If you wish to compare the transparency of the atmosphere on two days, or in two different places, two circles will be sufficient for the experiment.

According to these principles, M. de Saussure caused to be prepared a piece of white linen cloth eight feet square. In the middle of this square he sewed a perfect circle, two feet in diameter, of beautiful black wool: Around this circle he left a white ring two feet in breadth, and the rest of the square was covered with pale green. In the like manner, and of the same materials, he prepared another square; which was, however, equal to only $\frac{1}{12}$ of the size of the former, so that each side of it was 8 inches; the black circle in the middle was 2 inches in diameter, and the white space around the circle was 2 inches also.

If two squares of this kind be suspended vertically and parallel to each other, so that they may be both illuminated in an equal degree by the sun, and if the atmosphere, at the moment when the experiment is made, be perfectly transparent, the circle of the large square, which is twelve times the size of the other, must be seen at twelve times the distance. In M. de Saussure's experiments, the small circle disappeared at the distance of 314 feet, and the larger one at the distance of 3588 feet, whereas it should have disappeared at the distance of 3768. The atmosphere, therefore, was not perfectly transparent. This arose from the thin vapours which at that time were floating in it."

New diaphanometers suggested.

The writer of this article, several years ago, made numerous experiments both with the diaphanometer of Saussure, and with other contrivances, but they were not attended with any very satisfactory results. One of the instruments which he employed, was a telescope with a variable magnifying power, produced by the motion of a second object-glass along the axis of the instrument. By this means, he got rid of the error arising from the adjustment of the eye to different distances; and that organ did not need the successive refreshments which Saussure found it to require. The magnifying power being known with the greatest accuracy from a scale on the moveable tubes, we had only to shift the moveable object-glass till the object vanished, and the magnifying power, indicated by the scale, became a relative measure of the transparency of the atmosphere. By this means we are enabled to extend our experiments to a much larger portion of atmosphere.

Diaphragm ‖ Diarbekr.

Another contrivance which we adopted, was a telescope having tubes twice the length of what was necessary for ordinary purposes, in order to allow the eye-piece to be pulled out a great way beyond the focal point of the object-glass, and to be pushed as far within it. When the telescope was adjusted to distinct vision, the object was seen with perfect clearness; but when indistinct vision was produced by pushing in or pulling out the eye-piece, the object of course vanished, and the distance of the eye-piece from the focal position, was obviously a measure of the transparency of the atmosphere. For farther information on this and analogous subjects, see *Mem. Acad. Turin.* vol. iv. where Saussure first published an account of his invention; Gren's *Neue Journal der Physik*, vol. iv. which contains Murhard's Paper; Tilloch's *Phil. Magazine*, vol. iii. p. 377; Bouguer's *Traité d'Optique sur la gradation de la Lumiere*, livre iii. 1760; and Lambert's *Photometria*, the last of which we have not seen, but it is referred to by Murhard. (π)

DIAPHRAGM. See Anatomy.

DIARBEKR, or Diarbek, from *Dhyar* a duke, and *bekr* a country, is the name of one of the pashaliks of the province of Armenia and the Ottoman empire. This pashalik, which, next to that of Erzeroon, is one of the largest in Armenia, is situated between the Tigris and the Euphrates, and is separated from the dependencies of Merdin by a small river, and by a branch of Mount Masius. The whole of the pashalik is difficult of access, from the number of mountains which it contains. It is interspersed with narrow and fertile valleys, and abounds in the most beautiful and romantic scenery. Diarbekr was formerly the name of an extensive province, which is now divided into different pashaliks. See Macdonald Kinneir's *Geographical Memoirs of the Persian Empire*. (π)

DIARBEKR, or Kara-Amid, the capital of the pashalik of the same name, and the *Amida* of the ancients. It is situated in a delightful plain or rather table land, at the vertex of a triangle formed by one of the inflexions of the Tigris, which encompasses it on the east. It is encircled with a prodigious wall, flanked with seventy-two towers. This wall is built of black stone, from which circumstance the city derived the name of *Kara-amid*, or the Black Amid. This wall, which is now in a ruinous condition, is described by Mr Kinneir as far superior, both in height and solidity, to any thing which he had seen either in Europe or Asia. He thinks that there is no doubt of its having been built by the Romans, and attributes the mistake of those travellers, who ascribe it to the Arabs, to the number of Kufic inscriptions which have been inserted into different parts of the walls and towers at a later period. The stile of architecture has no resemblance to that of the Arabs, and similar Arabic inscriptions are often found in the ruins of Persepolis, the castle of Shuster, and the Rock of Besitoon. The houses, which are built of stone, have a respectable appearance, but the streets, though well paved, are narrow and dirty. In this city there are two or three stately piazzas, well stored with corn and provisions, and all kinds of merchandise; and there is a large magnificent mosque, which was formerly a church belonging to the Christians. The castle, which is on the north side of the town, is encompassed with a strong wall. It has many courts and elegant buildings, in which the Pacha and his officers reside. The river Tigris, which in spring rises to a great height, is crossed by a bridge of twelve arches, situated about half a mile below the town. Mr Kinneir describes Diarbekr as having a grand appearance when viewed from a distance. "The elevation of the surrounding mountains," says he, "the windings of the Tigris, and height of the walls and towers, with the cupolas of the mosques, give it an air of grandeur, far above that of any other city which I have visited in this quarter of the world." The inhabitants manufacture cotton, silk, copper, and iron, and export it to Bagdad and Constantinople; but they are principally employed in dressing, tanning, and dyeing goat skins, commonly called Turkey leather. Great numbers of pilgrims frequent this city, and at some distance from the town there is a large village with a caravansera, where the caravans that go to or from Persia, find a cheaper accommodation than in the caravanseras within the town.

Diarbekr is said to have been founded by Taimuras. The Emperor Constans strengthened it with fortifications, and it was then regarded as the strongest place in Mesopotamia. In A. D. 359, however, it was taken by Sapor D'Ulaktaf, and in 505 by Cobades his descendant. The Arabs, the Silguckians, and the Attabeks, had it successively in their possession. It was pillaged in 1393 by Timour, became an independent state under the princes of the Black Ram, and was at last taken by Selim the First, from Shah Ismael Sefi.

The population of Diarbekr is reckoned at 30,000 souls, the greater part of whom are Turks, and the rest Armenians, Curds, Jacobites, and Catholics. The men are affable and courteous, and the women enjoy a great degree of liberty, and live in terms of intimacy with the Christian women. Distance from Merdin 60 miles; from Orfa 287; and from Malatea 172½. The position of this city as ascertained by Mr Simon, is in East Long. 39° 52′, and North Lat. 37° 55′ 30″. See Macdonald Kinneir's *Geographical Memoir of the Persian Empire*, p. 332—335. (π)

DIARRHŒA. See MEDICINE.

DIASCHISMA, in Music, (ℰ) an interval so named by Pythorus, the remainder when a limma is taken from an apotome. By some it is called the ancient comma, and the comma syntonum. It was the comma maximum of Boethius; the comma ditonicum of Kollman, and his major comma; the quint wolf of Earl Stanhope. It has also been called the tonemajor wolf, and is the *least sum* of the quint temperaments and wolves in a douzeave.

The ratio of the diaschisma is $\frac{524,288}{531,441}$; the component primes of which are $\frac{2^{19}}{3^{12}}$; its common logarithm is .9941148,6098, and its reciprocal .0058851,3902; in the Binary logarithms of Euler, or decimals of the octave, it is =.019550; in major comma logarithms, 1.0908429; in schismas, 12.007862405; in Farey's Notation, which we have chosen as a common scale or measure of intervals, it is = 12Σ + m. In tunable intervals, it is 5V—7 4ths, and may be correctly obtained on an organ, by tuning upwards five perfect major fifths, and downwards seven perfect minor fourths, either successively or alternately, as is most convenient, when the last sound will stand in relation to the first, as diaschisma. None of the 59 notes on Mr Liston's enharmonic organ are thus related to each other, although 13 intervals between adjacent notes thereon, differ from it only one schisma, and 26 others only two schismas, respectively. See *Philosophical Magazine*, vol. xxxix. p. 419.

The following equations, in terms of the several intervals, in Plate XXX. Vol. II. exhibit the relation of the diaschisma to each of the 30 intervals less than the least concord, respectively, and to several of the conchords, viz.

đ = Σ + c
= 2Σ + €
= 12Σ + m

đ = P — L	đ = 3c — ℰ	đ = 5T — 2 4ths
= π — χ	= 4c — ʃ	= 6T — VIII
= D — r	= T — 2L	= 5V — 7 4ths
= ∂ — D	= ʃ — 2€	= 12V — 7 VIII
= 2P — T	= 2ℰ — 3€	= 12 4ths — 5 VIII
= 2c — €	= 3ʃ — 4ℰ	

đ = Σ + 𝒻c + R	đ = 6Σ + f + R
= 2Σ + 𝒻€ + R	= 11Σ + f + F
= 3Σ + χ + R	= 11Σ + 3f + d
= 4Σ + r + R	

đ = 12d + 36f — 11m	đ = π + c — D
= € + r — f	= 𝒻 + Σ — D
= φ + 2Σ — f	= ∂ + Σ — π
= c + χ — r	= 𝒻 + 2Σ — π
= π + Σ — 𝒻€	= ʃ + Σ — ℰ
= D + 2Σ — 𝒻€	= 𝒮 + Σ — 𝒻
= π + 2Σ — 𝒻c	= 2ℰ + 2Σ — ʃ
= D + 3Σ — 𝒻c	= P + ∂ — 2𝒮
= π + r — R	= ʃ + ∂ — L
= D + χ — R	= S + Σ — L
= ℰ + Σ — €	= 𝕊 + Σ — S
= 2m + 22Σ — €	= 𝕊 + 2c — S
= 2m + 23Σ — c	= 𝒮 + 3c — S
= 4ℰ + 5Σ — 7c	= T + Σ — t
= ℰ + 𝒻c — D	= 𝕋 + Σ — T
	= 2P + c — 𝕋

đ = 2€ — m — 8Σ	đ = ∂ — φ — 4Σ	đ = T — 2𝒻 — 2ℰ
= D — f — 2Σ	= S — r — 2c	= 2T — 2t — €
= π — r — Σ	= 2S — r — P	= 3T — 2t — 2S
= π — f — 3Σ	= L — r — ʃ	= 3T — 3t — ℰ
= ℰ — € — Σ	= 𝕊 — 𝒻 — €	= 4T — 4t — ʃ
= ℰ — m — 9Σ	= S — S — 2€	= 𝕋 — 2L — c
= ℰ — R — χ		
= 𝒻 — c — r		

$\frac{t}{u}$đ be any small fraction of the diaschisma, or power of its numeral ratio, whose index is $\frac{t}{u}$; then will $\frac{1055729 \times u - 7153 \times t}{1055729 \times u + 7153 \times t}$ be equal to its numeral ratio extremely near.

If, for example, $\frac{t}{u} = \frac{1}{2}$, the theorem gives us $\frac{2104305}{2118611}$ as the approximate ratio of the half diaschisma or schisma of Galileo and Glareanus; and its logarithm will be found to differ only 1 in the eighth place of decimals from the true log. of ½đ. This interval is = 5.996068Σ + m, or 6 + Σ½m, and is = 2½T—4th. (ȝ)

DIASCHISMA OF BOETHIUS, is an interval, described as the half the limma, or ½L, which has by some writers also been called the Half Diesis, or Minor Semitone. Its approximate ratio is $\frac{585}{601\frac{1}{2}}$, found by a general theorem $\frac{(N+D)u-(D-N)t}{(N+D)u+(D-N)t}$, wherein N and D denotes the numerator and denominator of a small fraction, ($\frac{243}{256}$ in this case), whose $\frac{t}{u}$ power is to be sought in another vulgar fraction; the above ratio being true within less than the smallest known interval, or *m*. Its value, in Farey's notation, is $22.9251695\Sigma + f + 2m$, or $23\Sigma + \frac{1}{2}f + 2m$; its common log. $=$ .9886813,5414.

DIASCHISMA of Dr BUSBY, is an interval, the half of the minor semitone, or $\frac{1}{2}\mathcal{S}$; whose approximate ratio, found as above, is $\frac{97}{99}$, which differs only about $\frac{1}{4}$ m from the true interval. It is $=18.0708993\Sigma + 2m$, or $18\Sigma + \frac{1}{2}f + 1\frac{1}{2}m$. and its log. .9911356,1652.

DIASCHISMA of EULER, is an interval whose ratio is $\frac{2025}{2048}$, $= 10\Sigma m$, or the COMMA MINOR, which see.

DIASCHISMA of S. ROOTSEY, is an interval not diatonic, but intended as an approximation to the true đ mentioned above, whose ratio he states to be $\frac{73}{74}$, $= 12.0483985\,\Sigma + m$; its common log. being .9940911,4039.

DIASCHISMA TRIPLE, is a compound or multiple interval, which is mentioned here, from its resulting also, as simple or prime intervals usually do, from the subtraction of simple intervals, viz. $3đ = \mathcal{S} - f$, $= L - \varphi$, $= S + 4\Sigma - \mathcal{f}$, $= P + 4\Sigma - \partial$, $= \mathfrak{S} - c - f$, $= S - \mathcal{E} - f$, &c. Its ratio is $\frac{2^{57}}{3^{36}}$ which is expressed in large numbers, of which the first figures are $\frac{144111, \&c.}{150094, \&c.} = 35.850339\,\Sigma + f + 3m$, or $36\Sigma + 3m$. Its log. is .9823445,8294.

DIASPASIS, a genus of plants of the class Pentandria, and order Monogynia. See R. Brown's *Prodrom. Plant. Nov. Holl. et Ins. Van Diemen.* p. 586, and BOTANY, p. 175.

DIATESSARON, in Music, is an interval, sometimes called a tetrachord, whose ratio is $\frac{3}{4}$, $= 254\Sigma + 5f + 22m$, or the FOURTH *Minor*, which see.

DIATESSARON of HOLDER, an interval, improperly so called, whose ratio is $\frac{3}{16}$, $= 1478\,\Sigma + 29f + 128m$, or the EIGHTEENTH *Minor*, which see.

DIATONIC ELEMENTS, in Music, are the *Major* TONE (T), the *Minor* TONE (t), and the *Major* SEMITONE (S). By the combination of which three intervals, all others which occur in the music now in use, called the diatonic, may be derived. Intervals thus expressed, as Mr Liston has done throughout his valuable "Essay on Perfect Intonation," are said to be expressed in, or computed by a notation of diatonic elements; but Mr Liston follows Dr Robert Smith, in denominating the lesser interval a Hemitone, and marking it H, instead of S, which is used in our Table, Plate XXX. Vol. II. and in our several musical articles.

Mr Maxwell, in his "Essay upon Tune," calculates by these elements; but he calls them by the names Greater Tone, Lesser Tone, and Semitone, and marks them G, L, and S, instead of T, t, and S, as we do. Owing to the constant occurrence of negative signs, in the minuter parts of the calculations, unless that an octave, or $3G + 2L + 2S$, is added to every interval, as Mr Maxwell sometimes does to avoid them; and owing also to the want of any *apparent value* in the three terms *collectively*, this notation often fails to convey readily a most important piece of information, viz. which of two intervals, expressed in it, are the largest? As, for instance, whether is the c or ✕B, of Maxwell, p. 194, the most acute, or the largest intervals above the bass C? the former being 3 2 2, and the latter 4 2 0 in his Table, or the c and B'✕ of Liston, which are expressed by the same numbers: whereas, had Farey's notation been used, and these two notes been expressed by $612\Sigma + 12f + 53m$, and $602\Sigma + 12f + 52m$, it would at once have appeared that the former is the largest, and that the difference of them is $10\Sigma + m$, instead of the ambiguous difference $2S - G$, as Maxwell has it.

For all purposes of perfect harmony, or diatonic calculations, his *artificial commas*, or the first or largest only of his elements, Σ, might be used, as shewn in the Philosophical Magazine, vol. xxxix. p. 419, and by which the whole of the calculations, necessary for understanding and proving Mr Liston's system of perfect harmony, is reduced to the adding or subtracting of numbers, which rarely exceed three figures, and which surely need not deter any practical musician from the attempt, however slight his knowledge of arithmetic.

By some, the prime digits, 2, 3, and 5, have also been called Diatonic elements, because they are, in every instance, composed of these numbers, and no other prime digits, except 1, which does not affect ratios, or the multiplications or divisions by which they are compounded. See MUSICAL *Primes*. (ε)

DIATONICUM, DIATONUM, in the music of the Greeks, was distinguished among their *genera*, according to Euclid, Eratosthenes, Ptolemy, &c. by a tetrachord, ascending according to the following numerical ratios, viz. $\frac{243}{256} \times \frac{8}{9} \times \frac{8}{9} = \frac{3}{4}$, which, in our notation, (see Plate XXX. Vol. II.) is as follows, viz.

$$\begin{aligned} T &= 104\Sigma + 2f + 9m \\ T &= 104\Sigma + 2f + 9m \\ L &= 46\Sigma + f + 4m \\ \hline 4th &= 254\Sigma + 5f + 22m \end{aligned}$$

DIATONICUM EQUABILE, was a genus of Ptolemy, which, according to Dr Wallis, was thus composed, viz. $\frac{11}{12} \times \frac{10}{11} \times \frac{9}{10} = \frac{3}{4}$, whence we have,

$$\begin{aligned} \tfrac{9}{10} &= 93.000000\,\Sigma + 2f + 8m \\ \tfrac{10}{11} &= 84.401367\,\Sigma + 2f + 7m \\ \tfrac{11}{12} &= 76.598633\,\Sigma + f + 7m \\ \hline 4th &= 254.000000\,\Sigma + 5f + 22m \end{aligned}$$

DIATONICUM INTENSUM, or *Syntonum*, this most important of the Greek genera, according to Didymus, Euclid, and many other writers, had a tetrachord thus composed, viz. $\frac{15}{16} \times \frac{9}{10} \times \frac{8}{9} = \frac{3}{4}$, or, in our notation,

$$\begin{aligned} T &= 104\Sigma + 2f + 9m \\ t &= 93\Sigma + 2f + 8m \\ S &= 57\Sigma + f + 5m \\ \hline 4th &= 254\Sigma + 5f + 22m \end{aligned}$$

Or, accordi g to Ptolemy, thus,

$$\begin{aligned} t &= 93\Sigma + 2f + 8m \\ T &= 104\Sigma + 2f + 9m \\ S &= 57\Sigma + f + 5m \\ \hline 4th &= 254\Sigma + 5f + 22m \end{aligned}$$

Of all the numerous scales of musical intervals which the Greek musicians used, or their own or subsequent theoretical writers have pretended that they did, the two last only, called the Diatonic, (see DIATONIC *Elements*,) are now in use, since our chromatic scales differ essentially in their construction and use, especially on tempered instruments, from any that are found in the ancient musical writers.

According to Aristoxenus, in this genus the tetrachord was divided into 30 equal parts, and was thus composed, viz. $6+12+12=30$, or,

$$\frac{12}{30}\text{ths or } \frac{2}{5}\times 4\text{th}=101.598428\Sigma+2f+9m$$
$$\frac{12}{30}\text{ths or } \frac{2}{5}\times 4\text{th}=101.598427\Sigma+2f+9m$$
$$\frac{6}{30}\text{ths or } \frac{1}{5}\times 4\text{th}=\ \ 50.803145\Sigma+f+4m$$
$$4\text{th}=254.000000\Sigma+5f+22m$$

According to Archytas, Dr Wallis, &c. it was thus divided, viz. $\frac{27}{28}\times\frac{8}{9}\times\frac{7}{8}=\frac{3}{4}$, which in our notation is,

$$\frac{7}{8}=117.947096\Sigma+2f+10m$$
$$\frac{8}{9}=104.000000\Sigma+2f+9m$$
$$\frac{27}{28}=\ \ 32.052904\Sigma+f+3m$$
$$4\text{th}.=254.000000\Sigma+5f+22m$$

DIATONICUM MOLLE, or soft diatonic. This genus, according to Euclid, ascended by a hemitone or half major tone, an incomposite or spiss interval, and a trihemitone, composed of five quadrantal dieses or quarters of a major tone, making up the tetrachord, which, in our notation, will stand thus, viz.

$$\frac{5}{4}T=129.927135\Sigma+3f+11m$$
$$72.076796\Sigma+f+6m$$
$$\frac{1}{2}T=\ \ 51.996069\Sigma+f+5m$$
$$4\text{th}=254.000000\Sigma+5f+22m$$

The incomposite of this system was, it is said, by Dr Holder, accounted to be three quadrantal dieses, or $\frac{3}{4}T = 78.072865\Sigma+f+7m$, but which exceeds it by $5.996069\Sigma+m$, being $\frac{1}{2}d$, or the schisma of Galileo and Glareanus, which differences, as in the genus CHROMATICUM MOLLE, &c. (which see) is occasioned by the ancients having assumed, that two and a half major tones were equal to a fourth instead of $2\frac{1}{2}T=4\text{th}+\frac{1}{2}d$, as the fact is.

According to Aristoxenus, the tetrachord was here divided into 30 equal parts, of which the same was composed as follows, viz. $6+9+15=30$, or,

$$\frac{15}{30}\text{ths or } \frac{1}{2}\times 4\text{th}=126.9251695\Sigma+3f+11m$$
$$\frac{9}{30}\text{ths or } \frac{3}{10}\times 4\text{th}=\ \ 76.2716855\Sigma+f+7m$$
$$\frac{6}{30}\text{ths or } \frac{1}{5}\times 4\text{th}=\ \ 50.8031450\Sigma+f+4m$$
$$4\text{th}=254.0000000\Sigma+5f+22m$$

According to Ptolemy, it was, however, constituted thus, viz. $\frac{20}{21}\times\frac{9}{10}\times\frac{7}{8}=\frac{3}{4}$, or

$$\frac{7}{8}=117.947096\Sigma+2f+10m$$
$$\frac{9}{10}=\ \ 93.000000\Sigma+2f+8m$$
$$\frac{20}{21}=\ \ 43.052904\Sigma+f+4m$$
$$4\text{th}=254.000000\Sigma+5f+22m$$

And Dr Pepusch and Mr Overend are of opinion that this genus was as follows, viz,

$$T+E=125\Sigma+2f+11m$$
$$2S=\ \ 72\Sigma+2f+6m$$
$$S=\ \ 57\Sigma+f+5m$$
$$4\text{th}=254\Sigma+5f+22m$$

DIATONICUM TONICUM, was a genus of Ptolemy, which, according to Dr Wallis, was thus constituted, viz. $\frac{27}{28}\times\frac{7}{8}\times\frac{8}{9}=\frac{3}{4}$, which, in our notation, is as follows,

$$\frac{8}{9}=104.000000\Sigma+2f+9m$$
$$\frac{7}{8}=117.947096\Sigma+2f+10m$$
$$\frac{27}{28}=\ \ 32.052904\Sigma+f+3m$$
$$4\text{th}=254.000000\Sigma+5f+22m$$

This differs from one of the preceding genera, only by the arrangement of the intervals.

DIATONUM, in Music, according to Mr Henfling, is an interval whose ratio is $\frac{15}{16}$, $=57\Sigma+f+5m$, or the SEMITONE *Major*, which see.

DIAZEUTIC TONE, in Music, an interval whose ratio is $\frac{8}{9}$, $=104\Sigma+2f+9m$, or the TONE *Major*. See that article. (ε)

DICEROS, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p 258.

DICHONDRA, a genus of plants of the class Pentandria, and order Digynia. See Brown's *Prodrom. Plant Nov. Holl. &c.* p. 490; and BOTANY, p. 160 and 179.

DICHROMA, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 112.

DICKSONIA. See FILICES.

DICOTYLEDONES. See BOTANY, p. 78.

DICRANUM. See MUSCI.

DICTAMMUS, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 210.

DICTATOR. See ROME.

DIDELTA, a genus of plants of the class Syngenesia, and order Polygamia Trustanea. See BOTANY, p. 307.

DIDEROT, DENYS, a French author of considerable celebrity, was the son of a master-cutler at Langres, where he was born in the year 1713. He derived his elementary instruction from the Jesuits, who, finding him to be a youth of promising talents, were desirous of retaining him in their society; but he evinced no inclination for the ecclesiastical life, and his father, therefore, sent him to Paris to finish his studies, intending that he should follow the profession of the law. Diderot, however, exhibited an early partiality for literary pursuits, to which he addicted himself in a degree that was incompatible with the duties of his situation. His father having taken offence at his conduct, refused, for some time, to continue his support. But young Diderot, undismayed by difficulties, continued to prosecute his studies in physics, geometry, and metaphysics, in which, and in the *belles lettres*, he made considerable progress. He commenced his career as an author about the age of thirty; and one of the earliest of his publications was a translation of Stanyan's History of Greece from the English. In 1745, he published a small work, entitled *Principles of Moral Philosophy*; and in the following spring appeared his *Pensées Philosophiques*, which procured him considerable reputation. From this period he was regarded as a disciple of the new philosophy, of which he afterwards became one of the most able and indefatigable advocates. He republished his *Pensées* under the title of *Etrennes aux esprits forts*, when they obtained a very general circulation, and contributed greatly to the dissemination of those philosophical opinions which were for a long time so prevalent in France.

About this period, Diderot, in concert with D'Alembert, laid the foundation of the famous *Dictionnaire Encyclopedique*; a work which formed a sort of epoch in the annals of science, and which appears to have been intended to serve, not only as a magazine of all human knowledge, but as an engine to subvert all established opinions. The first edition of this work was published between the years 1751 and 1767, in 28 volumes, folio. The reader may be desirous of knowing something of the history of the conduct and progress of an undertaking, which had so great an influence on the current of public opinion; and the *Memoires* of Baron

Grimm, lately published, have furnished us with some anecdotes relative to the publication, not previously brought to light, which are too curious to be omitted.

M. le Breton, first printer in ordinary to the king, had an interest, to the extent of one half, in the profits of the Encyclopædia, and was besides charged with the printing of the whole work. The other half was shared among three booksellers, two of whom died; in consequence of which, le Breton and Briason came to be the exclusive proprietors of the whole. These two individuals, therefore, divided among them the whole profits of the work, leaving to Diderot all the glory, the danger, and the persecution. His stipend, as editor of a work which occupied one half of his life, was fixed at 2500 livres for each of the seventeen volumes of treatises, and a sum of 20,000 livres in one payment. The Encyclopædia, from its commencement, had incurred the censure of government, and been made the object of proscription. In order to prevent new prosecutions during the further progress of the work, it was resolved to publish the ten last volumes together; and with a view to procure a knowledge of the seizures ordered by the police, and to avoid the impediments which fresh informations might throw in the way of the continuation of the undertaking, M. le Breton obtained the censorship of the trade. These precautions insuring safety during the progress of the impression, le Breton became anxious also to avert the storms which he conceived might threaten him after publication; and, for this purpose, he adopted a plan, which is probably unparalleled in the annals of book-making. The different articles were printed off as they came out of the hands of the several contributors; but after Diderot had revised the last proof of each sheet, Le Breton and his associate took possession of the copy, cut, retrenched, suppressed all that appeared to them too bold, or calculated to excite the clamours of the enemies of the work; and thus, of their own authority, reduced the greater number of the best articles to the state of mutilated fragments. The impression was drawing towards a close, when Diderot, having occasion to consult one of his great philosophical articles in the letter S, found it entirely mutilated; and upon further examination, he discovered that the same plan had been pursued in regard to the whole of the leading articles furnished by himself and his ablest co-adjutors. This discovery threw him into a state of phrensy and despair, which may be more easily conceived than described. The evil, however, did not admit of a remedy; the injury that had been committed was irreparable. The manuscripts had been destroyed; and they were already arrived at the impression of the last volume. Besides, the friends of Diderot advised him, for his own sake, to preserve silence in regard to the breach of trust of which the printer had been guilty; because it was impossible for him to make the public acquainted with the facts, without furnishing his enemies with a legal proof of his continuing to be the editor of the dictionary, after it had been suppressed by authority, which would probably have forced him to quit his native country. It is remarkable, as Baron Grimm observes, that no complaint on the subject of these proceedings was ever uttered by any of the authors of the different articles, and that the fact of the mutilation was never known to more than four or five individuals.

To the *Dictionnaire Encyclopedique,* Diderot devoted the labour of almost twenty years; during which period he, however, found leisure to publish several separate works, some of which were useful and creditable to his talents; while others, particularly his *Bijoux Indiscrets,* proved detrimental to his own reputation, and injurious to the morals of his countrymen. The Encyclopædia, although a very popular work, was, as we have seen, profitable only to the booksellers, and produced to the editors no adequate remuneration for the time and labour which they had bestowed upon it. * After it was brought to a conclusion, Diderot's affairs were so much involved, that he was obliged to come to the resolution of selling his library, which was purchased by the Empress Catherine of Russia; who, with a rare liberality that does credit to her memory, paid him 50,000 livres for it, or, according to Baron Grimm, 66,000 livres, and, at the same time, allowed him to retain the use of it during his life.

Diderot seemed more desirous of resting the reputation of his literary character on his productions in the department of the *belles lettres,* than upon his scientific labours. When he produced his two comedies, *Le Pere de Famille,* and *Le fils Naturel,* he wished to be considered as the inventor, as he was the eulogist, of that species of the drama, which is known among us by the name of *sentimental comedy,* and which the French denominate *Comedie larmoyante, Tragedie domestique,* or *bourgeoise.* But this kind of comedy had been previously introduced by Paul Landois, an obscure and now almost forgotten author; and afterwards attempted, with more ability and greater success, by La Chaussée. The comedies of Diderot do not exhibit much dramatic genius. His dialogue is stiff and sententious, and his characters too romantic for real life.

Diderot published several memoirs on mathematical subjects. He applied himself particularly to the study of music, and drew up, in dialogues between master and pupil, a luminous and pleasing treatise on the elementary principles of that science, and the art of performing on the piano-forte. Among his miscellaneous works, there is also an excellent essay on acoustics. Besides, he is said to have left behind him in manuscript, a quantity of observations on music sufficient to fill a quarto volume.

The fame of Diderot will perhaps be found ultimately to rest, in a great measure, upon the share he had in the publication of the *Dictionnaire Encyclopedique.* During his lifetime, he probably owed much of the reputation he enjoyed, to his talent for that species of animated conversational eloquence, which is capable of communicating its own enthusiasm to all around, and which is better adapted to the social circle or the literary *coterie,* than to the study of the man of science. His style of writing is by no means correct. He frequently endeavours to clothe common-place ideas in pompous language; and, although sometimes luminous and instructive, he is often obscure, feeble, superficial, and affected.

He died suddenly as he was rising from table, in the month of July 1784. (*z*)

DIDO. See CARTHAGE, p. 560, 564.

DIDYMANDRA, a genus of plants of the class Polygamia, and order Monœcia. See BOTANY, p. 343.

DIDYMELES, a genus of plants of the class Diœcia, and order Monandria. See BOTANY, p. 333.

* Voltaire mentions, that four editions of this work, which had been proscribed in France, were printed abroad; and that about eighteen hundred thousand crowns thus went into the pockets of foreigners. See Grimm's *Memoires,* vol. i. p. 344.

Didymus || Van Diemen's Island.

DIDYMUS' GENERA, in Music, were among the many modes which the theoretical writers on the Greek scales had, of dividing the tetrachord, or minor fourth. According to Dr Wallis, the genera of this author were as follows, viz.

$$\text{Enharmonic } \tfrac{31}{32}\times\tfrac{30}{31}\times\tfrac{4}{5}=\tfrac{3}{4}=\text{4th.}$$
$$\text{Chromatic . } \tfrac{15}{16}\times\tfrac{24}{25}\times\tfrac{5}{6}=\tfrac{3}{4}$$
$$\text{Diatonic . . } \tfrac{15}{16}\times\tfrac{9}{10}\times\tfrac{8}{9}=\tfrac{3}{4}$$

Two of these in the enharmonic, involves primes higher than 5, and are inconsistent with our present music. (e)

DIDYNAMIA. See BOTANY, p. 74 and 242.

DIEMEN'S ISLAND, VAN, is an island which, from the year 1642, was believed to be an integral part of New Holland, until recent observations have proved its separation from that extensive territory by a channel called Bass' Straits, bounding it on the north. It approaches to a rectangular form, being about 160 miles in length, and 80 in breadth; and its most southern point, Cape South, lies in 43° 42′ South Lat. and 146° 56′ East Long.

This island is surrounded by several others of various sizes, such as De Witt's isles, Schouten's, Bruny's, and Maria's islands to the south and east; and those of Furneaux and others to the north. Bruny's island is of a very singular appearance, consisting of two high mountainous territories, separate and distinct for a considerable interval, but connected by a low narrow neck of land; on the eastern coast of which is Adventure Bay, a port hitherto erroneously described as pertaining to Van Diemen's Land: but Bruny's island is divided from it by a channel discovered by the French in 1791, and named by them D'Entrecasteaux's Straits. In general, isthmuses are common on the coast, and frequently terminate by a high promontory: Even Van Diemen's Land presents a bold and rugged front to the southern ocean; lofty basaltic columns resist the turbulence of the waves, and the proximity of sterile pointed rocks, detached from the main-land, attest, that their separation has been effected by continued tempests, or some catastrophe of nature. Nevertheless, its shores are in many places penetrated by deep and capacious bays, forming safe harbours for shipping, and occasionally fresh water streams are discharged into them. The interior consists of ridges of mountains, some almost bounded by the sea, interspersed by extensive plains and vallies of rich vegetable soil. Salt and fresh water lakes appear covered by innumerable birds; but, as on the continent of New Holland, there are few rivers, and scarcely more than one or two for a short distance navigable.

Climate.

The climate, in general, is temperate, though chill and stormy about the southern extremity, except in the summer season; and snow lies on the mountains during several months of the year. Sometimes hot and sickly winds blow impetuously from the north, resembling the air at the mouth of an oven: the whole human body feels as if in a vapour-bath; vegetation is then totally blighted, and the putrefaction of animal substances accelerated in a remarkable degree.

Mineralogy.

The mineralogy of this island has not yet been sufficiently explored, to enable us to speak of it in detail. Metallic indications are rare, schist and granitic rocks abound, small quantities of coral have been discovered, and petrifactions of wood and shells are found at a great height above the level of the sea. But it is otherwise with the animal and vegetable creation; there immense variety appears, all new and unknown on the old continents of the world. Trees attain the incredible size of 180 feet in height, and 36 in circumference, and exhibit, in their decay, the evidence of the most remote antiquity. While the top is still in foliage, the trunk has wasted away to a slender ring, affording, in the interior cavity, an insecure habitation to the rude natives of this distant region.

Forests.

"The dark forests of Van Diemen's Land present a remarkable spectacle: These are the ancient offspring of time and nature, where the blow of the axe has never resounded; where unrestrained vegetation, daily becoming richer from its own products, meets with no obstruction; and which excite still greater interest, from consisting exclusively of trees unknown in the civilized world, and vegetables singular in organization. There a mysterious gloom perpetually prevails, a refreshing coolness, and a penetrating humidity; there, are overgrown trees mouldering down with age, from which so many vigorous scyons are springing; mosses and parasite lichens cover the massy trunks, now decomposing by the united action of time and moisture; while cold bodied reptiles or insects are harboured within in legions. All the avenues of the forest are obstructed by them; they cross each other in a thousand fashions, forming so many protecting barriers, which oppose the progress of the traveller, and multiply the dangers around him. Sometimes the slippery and decaying bark yields under his feet, or, sinking by his own weight, he is buried amidst the surrounding fragments. Sometimes they are heaped together in ramparts of twenty-five or thirty feet in height; or, fallen over the bed of torrents, they constitute so many bridges, which the passenger must cross with distrust. But amidst this scene of ravages and disorder, nature universally rears all that is most imposing by her creative power. Every where are seen in flourish, beautiful mimosas, superb metrosideros, and elegant correa, which are strangers to our native regions." Yet in this profusion there is scarcely a vegetable adapted for the sustenance of mankind; for, excepting the rarest instances, neither roots nor fruits have been discovered which may be converted to that purpose. The soil, besides, though in many places rich, owes its chief fertility to the immediate decomposition of vegetable matter.

Fishes.

The mollusca tribes, in the neighbouring seas, are innumerable, and have added infinitely to that branch of natural history which is still so imperfectly illustrated. Quantities of fish approach the shores, and, at certain seasons, may be taken with much facility; at low water, abundance of oysters, mussels, and the like, are procured of the finest quality; and many curious shells, which have lost their inhabitants, are washed up by the tide.

The cetacea are likewise very numerous in the vicinity; and the phocæ, sometimes almost covering the desert islands, have afforded an opportunity of establishing profitable fisheries.

Birds.

Uncommon beauty and variety are displayed among the feathered race: Besides the birds, of which analogous species are seen in Europe, there are cocatooes, black-spotted parroquets, pelicans, and the black swan, so long thought to exist only in fable. Flocks in hundreds cover the lagoons, where they shew wonderful sagacity in evading pursuit; and if followed by a boat, instead of directing their course straight forward to escape, always endeavour to gain the wind to aid their progress.

Nature has been peculiarly sparing in the distribu-

Van Diemen's Island.

Quadrupeds.

tion of quadrupeds in Van Diemen's land and its adjacent islands; but none of the few that are found there are said to exist on the old continents. The kangaroo, which is most numerous, is a quadruped resembling an enormous rat, with the fore legs so short that it can scarcely, if ever, use them in running; nevertheless its speed is considerable, and it can leap to a great distance when hunted. Its common progression is on the hind legs only, and it can rest unsupported by them on the root of a strong, broad, and muscular tail. The kangaroo forms paths through the thickest part of the brushwood, which commonly terminate at a rivulet. The wombat, an animal of equally singular structure, belongs exclusively to these regions: it is low and squat, the size of a turn-spit dog, weighs between twenty-five and thirty pounds, and has hardly any perceptible tail; the face of a triangular figure, somewhat resembling that of a cat, and is provided with strong whiskers. It burrows in the earth, perhaps as a retreat in time of danger: it is an extremely mild and docile animal, and now is seen in a domesticated state among the British settlers. We have also indistinct accounts of some other animals, such as that called the porcupine ant-eater by Mr Bass and Captain Flinders, which burrowed by sinking backwards among light sand, and always presented its prickly back to their dogs, which were unable to make any impression on it. M. Crozet speaks of a tiger cat, and the print of a carnivorous animal's foot as large as that of a dog. M. Labillardiere and M. Rossel saw the bones of a carnivorous animal; and a very fierce creature, described as a hyæna, is reported lately to have been discovered in the north parts of the island. Farther information, however, is necessary before naturalists can decide on the genus to which it pertains.

Inhabitants.

The inhabitants are also scantily disseminated throughout Van Diemen's Land; nor, without the benefit of civilization, is the country adapted for a numerous population. Some slight differences apparently exist between their structure and that of the inhabitants of other parts of the world, and even those of the neighbouring coast of New Holland. The head is of great size, and of uncommon length from the chin to the sinciput; the upper jaw of children projects, but resumes the ordinary shape in adults; the shoulders are broad, the thighs fleshy, but the legs and arms are slender, and deficient in that muscular consistence which is proper to the human extremities. The belly also is large, prominent, and exhibits a kind of unnatural intumescence. Various speculations have been indulged respecting the cause of these appearances; the former is thought to result from sparing and unsuitable aliment, added to the difficulty of obtaining it; and the latter, though with little likelihood, is ascribed to the want of compression from apparel. These people have woolly hair, their skin is not of a deep black, and their teeth are rather large and white. They are hardy and robust, going totally destitute of clothing even in the severest weather; but their personal strength is inferior to that of Europeans. Many of the women, however, have the skin of a kangaroo thrown across their shoulders, principally for the purpose of supporting their children; and some of the men are occasionally seen with the same habiliment. The latter allow the hair of the head and beard to grow; it is bedaubed with grease and red ochre, forming into a filthy matted heap. The women crop their hair close, and wear a string around the head. Both sexes blacken the skin with a composition of grease and very fine charcoal, or plain charcoal rubbed down between their hands, an ornament which they are very fond of bestowing on their European visitors. They tattoo themselves with great symmetry, the skin rising in low tubercles, though of the same colour as the rest, and the women form three semicircular lines of this description across the abdomen. The natives of Van Diemen's Land are altogether unskilled in the arts. In the lowest stages of ignorance and degradation, they have not even learned to secure their persons by clothing from the inclemency of the elements. Their habitations are only rude barriers against the wind, from which they shelter themselves on the opposite side; or they take refuge in the cavities of the enormous trunks of decaying trees, which they contrive to enlarge by fire. These excavations, which are of such a size that several men may be stretched at length within their bounds, always open from the east, probably to protect their tenants from the more prevalent storms, or it may be that decay commences in that quarter first. Seven or eight of their miserable huts, if such they can be called, or even fourteen, stand together; they are constructed of bark torn in long stripes, after being cut below, from some neighbouring tree, and of such breadth that the strength of their arms enables them to detach it from the wood. This bark is then broken into suitable lengths, and placed in an inclined position against the elbowing part of a dead branch that has fallen from the distorted limbs of the gum tree; and the pieces are so adapted as to preclude the access of rain.

Utensils.

These people can scarcely be said to possess tools or utensils. By means of a fragment of granite, or a shell sharpened on the edge, they detach the bark for constructing their dwellings, and also form short clubs and lances, which latter are from 16 to 18 feet in length, besides another implement, a wooden spatula, to remove shell-fish from the rocks. Their baskets are made by tying the two ends of a large bunch of long wiry grass to the two ends of a smaller bunch; the large bunch spread out constitutes the basket, while the smaller bunches serve for a handle. Notwithstanding this rude and original contrivance, baskets made of reeds, of very elegant and singular construction, have been seen among them. A drinking vessel, or one to carry water, is obtained by thrusting two wooden pins through the edges of a large flat leaf of sea-weed, which, being closed together on the pins, forms a sufficient cavity.

Canoes.

Some of the natives have slight canoes, from seven to nine feet long, formed of slips of the bark of trees, woven together with reeds, and tied up at the ends. In these frail embarkations they commit themselves to the waves; and in case of surprise, remove them from the water, and speedily run into the woods with them on their heads. But it does not appear that such belong to all the different tribes on the mainland, and they are more common on the detached islands surrounding its shores.

Customs.

The inhabitants of Van Diemen's Land constitute erratic hordes, united by no bond of common interest, except the facility of procuring sustenance. Perhaps they have inland dwellings, as yet unknown to strangers; for at certain seasons of the year they resort towards the coast, when the smoke of their fires, at first seen at great intervals, which daily diminish, is at length more concentrated towards the south or eastern points of the island. It has been remarked, that they constantly hover over large fires, though without any apparent necessity, and that such are kept burning day and night around them. They subsist almost entirely on shell-

Van Diemen's Island.

fish, the charge of procuring which devolves on the women, as well as its future preparation. Each, on these occasions, provides herself with a basket, and leaping from a rock into deep water, detaches them with her wooden spatula below. This is severe and exhausting labour; the women return to the surface only to breathe until their baskets are full, and they remain so long at the bottom, that European spectators are wont to be alarmed lest they have been entangled among the weeds, or have become a prey to ravenous fishes. Daughters are employed along with their mothers, and their collections are first brought as a tribute to the men. On emerging from the water, they carefully dry themselves before fires, and then prepare their food, which consists of lobsters, oysters, mussels, and chiefly of the ear shell. During their repasts, which continue remarkably long, each family separates from the general horde, and gathers round the fire to partake of it. But the labour has to be daily renewed, as little provision is made for future necessities. Nothing is grateful to the Diemenese that is used by Europeans: bread is rejected, nor will they permit their children to taste it. The women are apparently in absolute subordination to the men, and bear many indications of their savage ferocity. But the men are in no subordination to each other; they are void of all laws, regulations, or goverment, so far as is hitherto ascertained; they exist on the most perfect equality: nor do the whole people admit of any controul, except of husbands over their wives, and parents over their children. The nature of the alliance between the sexes is not clearly understood. Doubts may be entertained whether it be permanent; and although some transient visitors have conjectured that polygamy is practised among them, such opinions rest on a very slender foundation.

Custom of burning the dead.

A remarkable custom, that of burning their dead, is found among these savages; thus exhibiting in the rudest stages, what has been peculiar to men in the highest state of civilization. We are unacquainted with the detail of cremation, or whether it is practised after the same manner as on the coast of New Holland; but the ashes collected together are deposited in a small circular excavation, not exceeding eighteen inches in diameter, and ten in depth. A conical structure, neatly composed of bark, supported by poles below, and tied round above, is erected to cover them; and a sequestered spot, near some limpid rivulet, seems chosen for the purpose. Nevertheless, such structures, as also the remains of the dead, are of rare occurrence, even compared with the scanty population of the country. That they should be so, is in this manner explained from their nature: "The bark, by which they are protected, cannot fail to be speedily destroyed by the action of the atmosphere, or dispersed by the winds. The tender and delicate grass covering the ashes is likewise soon decomposed, and the ashes themselves, already partly scattered, can only present the appearance of a fire having been kindled on the spot; for the bones gathered together in the bottom of the excavation remain buried in the earth. None are therefore found on the surface; and we may add, as another reason, that the powerful calcination they have undergone renders their annihilation more immediate and complete."

Language.

Very litttle is yet understood of the language of the Diemenese, except that it abounds with vowels, is faintly articulated, and uttered with the greatest rapidity. It differs from that of all the surrounding nations.

Manners of the inhabitants.

Nothing has been more disputed than the natural character of man. Some have maintained that he is born, kind, tender, and benevolent, prone to the exercise of virtue; while others have contended, that vicious habits implanted in him, are displayed by ferocious cruelty and arrogance. But it is ignorance of the real savage state which has disguised the truth; and those opinions favourable to the disposition of our race, have been established on the early acts of docile children sprung from virtuous parents. Man, by nature, is sanguinary and tyrannical; and although none have yet been seen in stages of absolute degradation, void of every bond of union, and each providing solely for himself, still their inherent malevolence seems proportioned by their approaches to it. In general character, the natives of Van Diemen's Land are a lively people; they are frank and courteous to strangers, and ready to associate with them. Apparently they are divested of that cunning, and the love of vengeance, which actuates all other savages. Like children, they are occupied with novelties for the moment; and what is prized by them as a precious possession to-day, is thrown aside, or viewed with perfect indifference, to-morrow. The women are affectionate to their children, but the men are tyrannical to their wives; an infallible test of uncivilized society. Notwithstanding their evident placidity, their ready reception of strangers, and the willing assistance lent to them on all occasions, they are ever to be met with distrust; for treachery, if not invariably predominant in their thoughts, is too often only awaiting an opportunity to be practised. But these facts will be better illustrated, in taking a cursory sketch of the history of this territory, which, from various circumstances, has attracted unusual attention in Europe; partly excited, indeed, by the errors that have prevailed, and which even now prevail, concerning it.

Progress of discovery.

Abel Jansen Tasman, a Dutch navigator, being sent out on a voyage of discovery by the governor of Batavia, when in latitude 42° 25′, saw land ten miles distant, which, in honour of the governor, he named Van Diemen's Land; and on the 24th of November 1642, anchored in a bay, called by him Frederic Henry's Bay. He took possession of the country, by displaying the colours of his nation, and marking a post with the arms of the East India Company. Tasman saw no inhabitants; but remarking notches or steps five feet asunder on trees, he concluded that either they must be of extraordinary stature, or that they adopted some uncommon expedient for climbing them.

Tasman, 1642.

Possibly other navigators might visit these distant regions, more especially in the course of that numerous succession of voyages which we have historically enumerated in our general view of Australasia. But the next distinct account given of an inconsiderable portion of this island, is in a voyage by M. Marion du Fresne, a French officer, who unfortunately perished soon after.

Marion du Fresne, 1772.

On the 3d of March 1772, M. Marion came in sight of Van Diemen's Land, and brought his vessel to an anchor in Frederic Henry's Bay. Fire and smoke, seen the preceding day and night, announced that the neighbourhood was inhabited, and the herbage and foliage on the coast wore an inviting aspect. Thirty of the natives appeared and received their visitors, who had now reached the land, without any indications either of friendship or hostility. All were completely naked. The French, to gain their favour, offered them looking-glasses, handkerchiefs, and pieces of cloth, but every thing was rejected with contempt; nor would they accept of poultry, which had been brought from the ship. Their

Van Diemen's Island.

meagre appearance, broad shoulders, and woolly hair, struck the French; but the Diemenese expressed no signs of astonishment during the interview. Previous to this, a quantity of dried wood had been collected by the savages for a fire; and one at length separated from the rest to present a fire brand to M. Marion, and others, that they might set it in flames. M. Marion, considering this procedure to be a token of pacification, did not hesitate to apply the brand; but his error was quickly demonstrated, for kindling the fire seemed to prove a signal of defiance. No sooner had he done so, than the natives precipitately retired, and, from an eminence, saluted their visitors with a shower of stones, whereby he and their officer were wounded. The French immediately retaliated by a discharge of musketry, and then sailed along the bay to a supposed place of security. The savages followed, however; and having sent the women and children into the woods, opposed their landing by a flight of lances, one of which took effect. A second discharge of musketry killed one and wounded several of their number, whereupon, uttering hideous yells, they fled into the interior. These unprovoked aggressions established the real character of the Diemenese, which has sometimes been so egregiously mistaken; and future navigators may safely conclude, that the spears of savages are less designed for the destruction of wild animals, than for warfare with their own species.

Furneaux, 1773.

A year afterwards, Captain Furneaux, in the course of Captain Cook's second voyage of discovery, arrived at Van Diemen's Land; and in 1776, Captain Cook anchored there himself. He remained a few days, and had frequent interviews with the natives, by whom he was well received, and who approached him with perfect confidence. Nothing was known to him of M. Marion's adventure, which is not surprising, as no account of his voyage was then public, nor is it known even at this day in Britain, except to a few individuals; his anchorage besides was not in the same place. Captain Cook proposed to have set ashore a bull and cow, together with some sheep and goats; but apprehending they would be destroyed by the natives, he let loose a pair of pigs only.

Cook, 1776.

Scarcely any part of this country was explored, except the southern extremity and Adventure Bay, together with some of the adjacent islands; but it appears that European vessels occasionally touched on the coast. Captain Bligh, in completing the original purpose of his voyage for bringing the bread fruit tree from the Friendly Islands to the West Indies, anchored at Van Diemen's Land. His botanists planted several fruit trees and useful vegetables here in the year 1792, to which the soil and climate seemed well adapted.

Bligh, 1792.

Entrecasteaux, 1793.

Shortly after Captain Bligh's departure, two French vessels, under the command of Admiral D'Entrecasteaux, who had been sent out in quest of M. de la Perouse, reached Van Diemen's Land: a considerable portion of 1792 and 1793 was occupied in observations on the country, its products, and the disposition of the natives. But above all, an accurate hydrographical survey was made of the coast and islands, the result of which has lately appeared in a magnificent collection of engravings, executed by the order and at the charge of the present French government. Various learned men had, with laudable attention, been associated with the expedition; and by their united labours, an intimate acquaintance, compared with what was previously known of the Australasian regions, was obtained. The errors of Captain Cook and preceding navigators were corrected; and it was ascertained, that a considerable channel, which the French named D'Entrecasteaux's Straits, separated the adjacent islands on the east from the main land. They were received without reserve by the inhabitants, who assisted and promoted their objects; and certainly, on this occasion, manifested no symptoms of treachery, though they had their visitors completely in their power. In addition to planting such vegetables as were likely to prove useful to later navigators, the French set two goats at liberty, in hopes that their offspring might supply their wants.

Conjectured to be an island, 1797.

Van Diemen's Land was still believed to be the southern portion of New Holland; nor had navigators suspected any existing channel by which they were separated. "I need hardly say," Captain Cook observes, "that it is the southern point of New Holland, which, if it doth not deserve the name of a continent, is by far the largest island in the world." But in the year 1797, a vessel having been wrecked considerably to the south of Port Jackson, on an island, since called Preservation island, part of the crew were left there, while the rest went in quest of assistance. During the interval, they made some excursions in a small boat in different directions, and from their report, and other circumstances combined, the governor of the settlement conjectured, that there might be passages or straits running westward to the ocean, whereby Van Diemen's Land would be separated from the south coast of New Holland. These conjectures were further corroborated in the subsequent year, by Mr Bass, surgeon of the Reliance ship of war, who, during a voyage of twelve weeks in an open boat, sailed as far as 40° of south latitude. He visited every opening in the way; and from all his observations, concluded, that there was a channel between 39° and 40° of south latitude, rendering Van Diemen's Land an island; and he thought he might have performed a complete circumnavigation, had he been provided with a better vessel. In the end of the same year, Mr Bass had the satisfaction of ascertaining the truth. Accompanied by Lieutenant Flinders of the navy, he penetrated the supposed entrance into the channel, circumnavigated Van Diemen's Land, and returned to Port Jackson, from whence the voyage had been undertaken, early in January 1799. The period of the excursion had been limited by the governor to twelve weeks; but in the course of that time, in addition to the more important discovery of the main object in view, the navigators gained an acquaintance with many parts of the island which had never been previously visited. They opened a wide field of observation, and in the comparisons which were drawn between the territorial advantages enjoyed by the colony at Botany Bay, it became a subject of contemplation, whether subordinate settlements might not be profitably established on Van Diemen's Land. Scarcely any thing, however, except the margin of the island, had been visited: the natives were seldom seen, and very little knowledge obtained of their manners.

Discovered to be an island by Mr Bass, 1798.

Flinders, 1799.

Another expedition was planned by the French about the same period, of which the ostensible purpose was the promotion of scientific discovery: and certainly nothing was spared which, in this respect, might promise success. Twenty-three individuals embarked, whose sole province was to explore the nature and peculiarities of the regions they were to traverse; out of these, only three returned to their native country. Nevertheless, the object of their united labours was preserved, and we are thence enabled to judge of the research as bestowed on the island now under our considera-

Van Diemen's Island, Dieppe.

tion. The geographical discoveries are, perhaps, of less importance than those which were made in natural history, or there might be less opportunity for them, after the surveys of D'Entrecasteaux, particularly to the south and south-east of the island. Part of the years 1801 and 1802 were occupied in circumnavigation, and in observations on the coast. Some geographical errors were corrected, and the French ascertained, that several of what preceding navigators had supposed adjacent islands, were only so many lofty mountains, connected by isthmuses to the shore. But they made numerous and rich collections of the products of Australasia, both aquatic and terrestrial, from which many genera and species, heretofore unknown, have been constituted. Their interview with the natives, conducted with every precaution, led to the same conclusion that we have deduced from their conduct to M. Marion, that, although at one instant they prove courteous and amicable to strangers, in the next their innate treachery and ferocity will appear. The French had good reason to be satisfied, that none of their numbers fell victims to such a malevolent race. Yet various tribes may differ in character; and even comparing all that has been experienced from the Diemenese with the demeanour of many other savages, they are infinitely to be preferred. While some approached without reserve, others anxiously shunned their visitors, and retreated with loud clamours to the mountains. The whole country was set in flames, as if they were content by that sacrifice to drive them away; and they seemed to shelter themselves amidst columns of fire and smoke. Sickness compelled the French to abandon their researches on Van Diemen's Land, which were resumed at various intervals in the course of the voyage. Only part of their discoveries have hitherto been made public; and the death of M. Peron, in December 1810, interrupted the work devoted for that purpose; but the remainder, we have understood, was far advanced a considerable time ago, and was to be completed by one of the literati of the expedition, sufficiently qualified for the task. More recently, a British settlement has been established on this island, which is divided into different counties; two towns are founded; and the whole is said to be now in a flourishing condition. See Tasman's *Voyage; Nouveau Voyage a la Mer du Sud*; Collins' *Account of Botany Bay*, vol. ii.; Cook's *Third Voyage*, vol. i.; Peron *Voyage aux terres Australes*; La Billardiere *Voyage*; Rossel *Voyage de Dentrecasteaux*, tom. i. p. 54, 213; and *Memoire sur la vie*, de Peron. An account of the Botany of New Holland will be found in R. Brown's *Prodromus Plantarum Novæ Hollandiæ et Insulæ Van Diemen*, London, 1812. The plants which that able botanist discovered in this island, are likewise noticed in our article Botany. See also the articles Australasia, Maria's Island, and Preservation Island. (*c*)

DIEPPE, a sea-port town of France, in the department of the Lower Seine, and the principal place of a district of the same name, is situated between two rocky mountains on the English Channel, at the embouchure of the river Arques. The town is handsome and well built, and the streets are regular, straight, and spacious, particularly the high street, which is about a mile long. To an English eye, however, the aspect of the town is by no means agreeable, the fronts of the houses are black, the windows frequently filled with clothes hung out to dry, and the corners disfigured with spiders and other vermin. The pavement is also very inferior to those in English towns, the streets being cleaned by gutters running down the middle, with cuts on each side leading to the houses. The town has two suburbs, one of which, called the Paulet, is inhabited principally by fishermen and sailors. The principal public buildings are the parish church of St James's, which is a fine edifice, and from the tower of which the English coast can be distinctly seen; and the old castle, at the western end of the town, which is very badly fortified. Besides these buildings, there are two parish churches; nine religious houses, an hospital, and a hotel-dieu. There is a pleasant promenade on the ramparts.

Dieppe, Diesis.

The harbour, at the east end of the town, is in the form of a semicircle, has about 18 feet at high water, and has two very fine moles of strong brickwork about half a mile long. It contains only about 200 vessels of not more than 400 tons burden.

The principal manufactures of Dieppe are those of thread, lace, ivory and horn toys, and barrels. In the year 1788, the lace manufacture gave employment to about 4000 females and children, who were mostly the wives and daughters of fishermen, and its annual amount was estimated at 400,000 livres. It belongs to about 50 merchants established in Dieppe, who found a vent for it in the interior of the kingdom, in Spain, and in the American islands. The articles in ivory and bone are wrought with great skill, and sold at a very reasonable price, a figure of 8 or 10 inches, well finished, costing only about six livres. In the manufacture of barrels for the fisheries, more than 400 master coopers are employed.

The herring, whiting, and mackerel fisheries, are carried on to a great extent in Dieppe. During the nine years from 1781 to 1789 inclusive, about 58 vessels at an average were employed in the herring fishery, which produced at an average 6206 lasts of fish, worth about 1,820,900 livres. During the peace of Amiens, only 40,000 barrels were caught. The mackerel fishery, which employs about 45 vessels, produces annually about 280,000 livres, and the whitings, which are caught in December, January, and February, are sent to Paris in light carts, which travel both night and day. There are regular packet boats, in time of peace, between Dieppe and Brighton, a passage of 66 miles, which generally occupies from 10 to 24 hours. Population 20,000. East Long. 1° 4′ 44″, and North Lat. 49°55′ 34″. High water at spring tides 10^h 30′. A copious history of the trade and commerce of Dieppe will be found in Peuchet's *Dictionnaire de Geographie Commerçante*. See also Herbin *Statistique de la France*, and a *Tour in France in August* 1789. (π)

DIESIS, in Music, was originally, we are told, intended by the Greeks, to express certain intervals larger than a comma, but smaller than a semitone; yet this distinction has not been adhered to by more modern writers: but a great number of small intervals, and some larger, have received this name, and it is very necessary that the musical calculator should be apprised of these, which can only be done by having them expressed in the same notation, and placed in alphabetical order, as follows:

DIESIS of Boethius, and which also has been called by some, his diaschisma and his semitone minor, is the half limma (or $\frac{1}{2}$ L) $= 22.9251695\Sigma + f + 2$ m, or $23\Sigma + \frac{1}{2}f + 2$ m, and its common log. is .9886813,5414. It is $= \frac{1}{4}t - \frac{1}{4}\Sigma$, and its approximate ratio, found by our theorem in the article Diaschisma, is $\frac{985}{1011}$ very nearly.

DIESIS of Euclid, in his enharmonic sescuplum genus, is stated to be sesquialtera to the enharmonic diesis, (or $\frac{3}{2}\mathcal{E}$) = 31.35082014Σ + f + 2m, or $31\frac{1}{2}$Σ + 3m, and its log. = .9845500,6504.

DIESIS of Mercator, according to Dr Holder, is $\frac{2}{53}$d parts of the octave, = 2 of his artificial *commas*, = 23.0124496Σ + f + 2m, or $23\frac{5}{53}\Sigma + \frac{20}{53}L + 2m$, and its log. = .9886403,7752 = .03773584 × VIII, = 2.1055714 × c.

DIESIS CHROMATIC of Dr Calcott, (∂) its ratio is $\frac{16384}{16875}$ = 26Σ + 2f + 2m. See CHROMATIC *Diesis.*

DIESIS CHROMATIC of Hoyle ($\frac{1}{2}$T) has a ratio $2\sqrt{2} \div 3$, = 52.0039312Σ + f + 4m, or 52Σ + f + $4\frac{1}{2}$m, its common log. = .9744237,3877, its Euler's log. = .084962, and its major comma log. = 4.74070.

DIESIS DOUBLE ENHARMONIC, (or 2 $\mathcal{E}$) has a ratio $\frac{15625}{16384}$ or $\frac{5^6}{2^{14}}$ = 41.858201Σ + f + 3m, or 42Σ + 4m, and its log. = .9794000,8672; it is = S + R, = f + € = đ + 3 € = S — ∂, = 4c — 2Σ, = 2t — 4S, 4đ — 6Σ, = 4S — 2t = S — π, = 2 6ths — 4 IIIds = 2 VIII — 6 III, by either of which two last equations, it may be tuned on an instrument like Mr Liston's organ.

DIESIS DUODECIMAL of Aristoxenus, used in forming his genera or scales of music, and said to be practised by the Greek musicians, was $\frac{1}{30}$th of the minor fourth, = 8.489514Σ + m, or $8\frac{7}{15}\Sigma + \frac{1}{6}f + \frac{11}{15}m$, and its log. = .9958353,7545. Dr Holder informs us, that this interval was so named, because it was thought to be the twelfth part of the major tone; but the latter exceeds the former by more than $\frac{1}{5}$Σ, or .200131Σ. It is = .0138346 × VIII = .771937 × c = 8.497376 × Σ.

DIESIS ENHARMONIC, (or $\mathcal{E}$), has the ratio $\frac{125}{128}$ = 21Σ + 2m. See ENHARMONIC DIESIS.

DIESIS, GRAVE, of Liston, and his grave diminished second, (or €), = $\frac{2025}{2048}$ = 10Σ + m, or the COMMA MINOR, which see. Mr Liston observes, that this interval is near $\frac{1}{10}$th of a major tone, but which is 10.762226Σ + m.

DIESIS, GREATER, of M. Capella, is represented to be $\frac{1}{38}$ (XII — 19$\mathcal{S}$), or 7.524038Σ + m.

DIESIS, GREATER ENHARMONIC, of Hoyle, ($\frac{3}{4}$T) = 78.0728649Σ + f + 7m, or 78Σ + $1\frac{1}{2}$f + $6\frac{3}{4}$m, and its common log. = .9616356,0816.

DIESIS, GREATER ENHARMONIC, of mean tone temperament, 21Σ + 2m (or $\mathcal{E}$). See DIESIS OF TEMPERED SCALES, and our article ENHARMONIC DIESIS.

DIESIS, GREATER, of Quintilian, according to Dr Wallis, had a ratio $\frac{34}{35}$, = 25.52019Σ + f + 2m, its log. being .9874108,7269.

DIESIS, GREATER, of Rootsey, and which he also calls a quarter of a tone, and also an enharmonic semitone, has a ratio $\frac{42}{43}$, = 20.835156Σ + 2m, and its log. = .9897808,3482.

DIESIS, LESSER, of M. Capella, is stated to be $\frac{1}{34}$th (11th — 17S), or 7.468275Σ + m.

DIESIS, LESSER CHROMATIC, of Chambers, Good, Holder, &c. (or S), has a ratio $\frac{24}{25}$ = 36Σ + f + 3m. See SEMITONE MINOR.

DIESIS, LESSER ENHARMONIC, of Hoyle, ($\frac{1}{4}$T). See DIESIS QUADRANTALIS of Euclid.

DIESIS, LESSER ENHARMONIC, of mean tone temperament, which falls between ※B and ♭C, and between ※E and ♭F, where the half tones are situate, is = 17.8937641Σ + 2m, or $17\frac{3}{4}$Σ + f + $1\frac{1}{4}$m, and its log. = .9912224,3171. See DIESIS OF TEMPERED SCALES.

DIESIS, LESSER, of Quintilian, according to Dr Wallis, had a ratio $\frac{35}{36}$, = 24.798335Σ + f + 2m, and its log. = .9877655,4358. Mr Holder, in different parts of his works, calls this interval the Accidental Temperament, bearing comma, and quarter of a tone.

DIESIS, LESSER, of Rootsey, and which he also calls a quarter of a tone and an enharmonic semitone, has a ratio $\frac{88}{89}$, = 8.988363Σ + m, and its log. = .9955908,8108.

DIESIS, MAJOR, of Lord Brouncker, Holder, &c. (S), = $\frac{24}{25}$, = 36Σ + f + 3m, or the SEMITONE MINOR, which see.

DIESIS MAJOR, of Maxwell, (€) has a ratio $\frac{2025}{2048}$, = 10Σ + m or the COMMA MINOR, which see.

DIESIS MAJOR, of Quintilian, according to Dr Wallis, had a ratio $\frac{32}{33}$, = 27.10245Σ + f + 2m, or 27.251706Σ + 2m, and its log. = .9866360,3844. M. Chladni observes, that this is the error (※) of the trumpet fourth. See our article CHROMATIC FRENCH HORN.

DIESIS MINOR, of Maxwell (Σ), has a ratio $\frac{32768}{32805}$, = Σ, or the SCHISMA, which see.

DIESIS MINOR, of Quintilian, according to Dr Wallis, had a ratio $\frac{33}{34}$, = 26.28796 + f + 2m, and its log. = .9870350,2284.

DIESIS QUADRANTALIS of Aristoxenus, was $\frac{3}{30}$th of the minor fourth, or $\frac{1}{10}$ × 4th, = 25.32674Σ + f + 2m, or $25\frac{2}{5}\Sigma + \frac{1}{2}f + 2\frac{1}{5}m$, and its log. = .9875061,2634.

DIESIS QUADRANTALIS of Euclid, was one fourth of the major tone, or $\frac{1}{4}$T, = $2 \div \sqrt{2}\sqrt{3}$, = 25.9271353Σ + f + 2m, or 26Σ + $\frac{1}{2}$f + $2\frac{1}{4}$m, and its log. = .9872118,6939. Mr Hoyle calls this the lesser enharmonic diesis.

DIESIS QUADRUPLE ENHARMONIC, (or 4 $\mathcal{E}$) has a ratio $\frac{244,140,625,}{268,435,456,}$ or $\frac{5^{12}}{2^{28}}$, = 83.708541Σ + 2f + 7m, or, 84Σ + 8m; its common log. = .9588001,7344, its Euler's log. = .136861, its schisma log. = 84.062904, and it is = 7.636628 × c.

This interval is an important one, as being the *least sum* of the tierce temperaments, in any douzeave system, or 4VIII — 12III = 4$\mathcal{E}$, on which account it has a place in our Table, Plate XXX. in Vol. II. Dr Boyce, Clagget, and Holder call it a *Note*. The following equations will shew some of its relations to other intervals, viz. 4$\mathcal{E}$ = 7đ + m, = 2S + 2R, = 2f + 2€, = 2S + 2∂, = 2đ + 6€, = 3f — đ, = 4t — 8S, = 8c — 4Σ, = 8đ — 12Σ, = 8S — 4t, = P + 2R + D = 2E + 4€ + 2Σ, = t — 2r — 5Σ, = 8 T — 8t — 4Σ, = 4 3ds + 4 4ths — 8III, = 4 6th — 8III, = 12 6ths — 9VIII, and = 4VIII — 12III, by which last and several preceding equations, this interval may be tuned.

DIESIS SESQUIALTERA of Aristoxenus, in his genus chromatic hemiolion, is reckoned $4\frac{1}{2}$ thirtieth parts of the minor fourth, or $\frac{3}{20}$ × 4th (and was supposed to be one and a half enharmonic diesis, whence the name) = 38.060494Σ + f + 3 m, or $38\frac{1}{10}\Sigma + \frac{3}{4}f + 3\frac{3}{10}m$, and its log. = .9812591,8951. This interval exceeds $1\frac{1}{2}\mathcal{E}$ by 6.606742Σ + m.

DIESIS SESQUIALTERA of Euclid, in his genus chromatic sescuplum, is $\frac{3}{8}$ths of a major tone, or $\frac{3}{8}$T, = 38.965533Σ + f + 3m, or 39Σ + $\frac{3}{4}$f + $\frac{27}{8}$m, and its log. = .9808178,0408. This interval was supposed equal to $1\frac{1}{2}$E; but the latter falls short of the former by 7.607332Σ + m.

DIESIS OF TEMPERED SCALES, are of two kinds, the greater and the lesser. Dr Robert Smith in his *Harmonics*, Prop. III. &c. shews, that in every regularly tempered system the octave is made up of five equal tones, and two equal major limmas, or VIII = 5T + 2L; the difference between these he calls a minor limma, or T — L = l, and the difference between the major and minor limmas, or L — l, he calls the DIESIS (D) of all such scales.

Mr Farey, in a paper in the *Philosophical Magazine*, vol. xxxvi. p. 40, has given several equations or formulæ for adapting Dr Smith's Interval to his notation, and for rendering the calculations of temperaments more easy and useful than heretofore. For this purpose he substitutes $\frac{r}{s}$ and $\frac{t}{u}$ for the fractions of Σ and m, of the temperament of the fifth, in any proposed regular system; each of such tempered fifths being therefore, $V - \frac{r}{s}\Sigma - \frac{t}{u}m$. And he finds

$$\text{In cor. 12.}\quad T = \frac{104s - 2r}{s}\Sigma + 2f + \frac{9u - 2t}{u}m.$$

$$\text{In cor. 11.}\quad L = \frac{46s + 5r}{s}\Sigma + f + \frac{4u + 5t}{u}m.$$

$$\text{In cor. 10.}\quad l = \frac{58s - 7r}{s}\Sigma + f + \frac{5u - 7t}{u}m.$$

$$\text{In cor. 9.}\quad D = \frac{12r - 12s}{s}\Sigma + \frac{12t - u}{u}m.$$

$$d = \frac{70s - 19r}{s}\Sigma + f + \frac{6u - 19t}{u}m.$$

The minor limma or *l*, expressing the value of a *flat* and a *sharp* throughout the scale, the greater *diesis* D, expressing the interval between the *sharps* and the adjacent *flats* of whole notes, or such as are unusually said to be *whole tones* asunder, as between C♯ and D♭, D♯ and E♭, F♯ and G♭, G♯ and A♭, A♯ and B♭, &c. and the lesser *diesis* (now for the first time published) đ, expressing the interval between adjacent *flats* and *sharps* of half notes, or where the *half notes* of the scale fall, as between E♯ and F♭, B♯ and C♭, &c. We will endeavour to explain this, by stating, as an example, the notes of a scale of 24 notes, such as Mr David Loeschman's patent organs and piano-fortes are capable of giving in any proposed temperament, from the *Phil. Mag.* vol.xxxix. p. 418, viz.

C, C♯ D♭, C♯♯ D, D♯ E♭, E F♭, E♯ F, F♯ G♭, F♯♯ G, G♯ A♭, A B♭♭, A♯ B♭, Bc♭, B♯c
l D d D *l* D *l* D d D *l* D d D *l* D *l* D d D *l* D d D

The upper line representing the notes, and the lower one the intervals between every two adjacent ones above.

By counting up the lower ones, it will be seen, that the octave is in this case made up thus, viz. VIII $= 7l + 12D + 5d$; and so it will be found by multiplying the formulas above by these numbers respectively, and adding the products together, viz. that $612\Sigma + 12f + 53m$ will result. Mr Loeschman prefers the *mean tone* system for his instruments, wherein every major third is perfect, and $\frac{r}{s} = \frac{11}{4}$ and $\frac{t}{u} = \frac{1}{4}$. See Mr Farey's 2nd Scholium in the volume first above quoted, which numbers substituted in the formulas above, give

$$l = \frac{232 - 77}{4}\Sigma + f + \frac{20 - 7}{4}m, = 38\tfrac{3}{4}\Sigma + f + 3\tfrac{1}{4}m,$$ the *sharp* and *flat* of this syrtem;

$$D = \frac{132 - 48}{4}\Sigma + \frac{12 - 4}{4}m, = 21\Sigma + 2m,$$ the greater Enharmonic Diesis; and

$$d = \frac{280 - 209}{4}\Sigma + f + \frac{24 - 19}{4}m, = 17\tfrac{3}{4}\Sigma + f + 1\tfrac{1}{4}m,$$ the lesser Enharmonic Diesis, as have been mentioned above.

On instruments which have only 12 notes in the octave, (as is the case on all common organs,) or 14, 16, &c. notes, when tuned to this scale, any of the intervals required may be found by help of the above Table, and values of *l*, D, and đ; thus, if the interval between C and D be sought, it is $l + 2D + d$, which will easily be found $= 98\frac{1}{2}\Sigma + 2f + 8\frac{1}{2}m$; if between C and E, it is $3l + 3D + d, = 197\Sigma + 4f + 17m$, or III, as it should be.

DIESIS Trientalis of Aristoxenus, in his genus chromatic molle, is stated to be four thirtieths of the minor fourth, (and was supposed to be equal to the third part of a tone, whence the name,) or $\frac{2}{15} \times$ 4th, $= 33.81626\Sigma + f + 3m$, or $33\frac{13}{15}\Sigma + \frac{2}{3}f + 2\frac{14}{15}m$, and its log. $= .9833415,0179$. It falls short of $\frac{1}{3}$T, by rather more than $\frac{1}{5}\Sigma$, or $.20052\Sigma$.

DIESIS Trientalis of Euclid, is one third of the major tone or $\frac{1}{3}T, = 2 \div \sqrt[3]{9} = 34.616779\Sigma + f + 3m$, or $34\frac{2}{3}\Sigma + \frac{2}{3}f + 3m$, and its log. $= .9829491,5919$; it is $= .056641 \times \text{VIII}, = 3.16047 \times c$.

DIESIS Triple Enharmonic, (or 3 Ɛ) has a ratio $\frac{1,953,125}{2,097,152}$, or $\frac{5^9}{2^{21}}$, $= 62.858201\Sigma + f + 5f$, or $63\Sigma + 6m$; its common log. .9691000,3008, its Euler's log. $= .1026459$, its schisma log. $= 63.047178$, and its comma log. $= 5.7274715$. The following equations will shew some others of its relations to the other intervals, in Plate XXX. Vol. III. viz. 3Ɛ = S + R, = 3C + 3€, = 6€ + 3Σ, = 6c − 3Σ, = 2*f* − Σ, = 6S − 3t, = 3𝕋 − 6𝕊, = 3t − 6S, = P + φ − ℝ, = 3 6ths − 6 III, ≐ 3 VIII − 9 III, by either of which last it may be tuned by perfect intervals. (*ę*)

DIERVILLA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 176.

DIET. See Aliments.

DIEU, Isle de. See Vendee La.

DIEUZE, a town of France, in the department of La Meurthe. It is situated on the river Seille, between Metz and Saverne, and has four convents and two hospitals. It is remarkable for its dyeworks, its manufactories of saltpetre, of hosiery and cotton goods, but particularly for its salt pits, which furnish annually 280,000 quintals of salt. The salt springs have existed since the beginning of the 11th century, and are the most considerable in Lorraine, both for their strength and copiousness. One hundred pounds of water furnishes 16 pounds of salt. The superfluous water is conducted by a canal to the salt-work of Moyenvic. The little river called the Spin, separates the salt works of Dieuze from the town. Population 3344. See Peuchet's *Dict. Commerçante*. Herbin *Statistique de France*; and Reichard's *Guide des Voyageurs en Europe*. (*j*)

DJEZAN Ras, Ghezan, or Gezan, is a seaport town of Arabia, in the principality of Abu Arisch, and the Province of Yemen. It is situated on the Red Sea, which forms one side of a large bay. The town is built with straw and mud, and carries on a considerable trade in senna, which grows in the adjacent country, and in coffee, which is brought from the mountains of Haschid-u-Bekil. The trade in coffee, however, has been in a great degree removed to Loheia and Hodeida. The town is well supplied with water, fruits, and excellent fish. It is particularly subject to fevers Its distance from Abu Arisch is about one day's journey. East Long. 42° 6′, and North Lat. 16° 53′, according to Lord Valentia's chart of the Red Sea. See Bruce's *Travels*, and Niebuhr's *Travels*. (*j*)

DIEZE, in Music, an interval, so called by Mr Edmund Stone, whose ratio is $\frac{24}{25}$, = 36 Σ + f + 3 m, or the SEMITONE *Minor*, which see.

DIEZE, DOUBLE MINIME, has a ratio $\frac{387,428,489}{400,000,000}$, or $\frac{3^{18}}{2^{10} \times 5^{8}}$, = 28.149661 Σ + f + 2m, or 28 Σ + 2 f + 2m; its log. = .9861225,9363. It is = 𝒻 + χ, = ∂ + r, = 3𝒻 — 𝕊, = 𝒻 + χ + Σ∂ + f + 2Σ, = 𝒻 + f + 3Σ, = 𝒻 + R — r, = 𝒻 + π — đ, = 𝒻 + P — 5c, = 𝒻 + 𝒮 — 3c, = 𝒻 + r — Σ, = ∂ + χ — Σ, = ∂ + L — 4 c, = ∂ + S — 5 c, = S + ∂ — 6 c, &c.

DIEZE MAJOR of Rameau, has a ratio $\frac{125}{128}$, = 21 Σ + 2 m, or the ENHARMONIC *Diesis*, which see.

DIEZE MAXIME of Rameau, has a ratio $\frac{243}{250}$, = 25 Σ + f + 2 m, or the SEMITONE *Subminimis*, which see.

DIEZE MINIME (D), an interval so named by M. Rameau, it being the remainder when the semitone minimum is taken from the limma. Its ratio is $\frac{19683}{20000}$, the component primes of which are $\frac{3^9}{2^5\ 5^4}$: its common log. is .9930612,9682, and its reciprocal log. .0069387,0318: in the Binary logarithms of Euler, or decimals of the octave, it is = .023054, in major comma logarithms 1.286130, and in schisma logs. = 14.157524. In Farey's notation, (see our article APOTOME, and Plate XXX. in Vol. II.), it is = 14 Σ + f + m, or when reduced to his regular increasing series, wherein negative signs are wholly avoided, either in the terms or the intervals between them, = 14.14966096 Σ + m.

In tuneable intervals, it is = 4-4ths — III — 5-3rds; and thus it may be tuned on an instrument like Mr Liston's, by ascending four perfect fourths, and from the upper note descending a major third and five minor thirds: none of the 59 notes on the euharmonic organ stand in this relation to each other, although four adjacent intervals thereon differ only a schisma in excess, being each C + f€ instead of € + f€. See the *Phil. Mag.* vol. xxxix. p. 419.

The equations which follow, expresssd in the symbols of Plate XXX. above referred to, will shew the exact relation of this interval to all the others in that Table, viz.

D = đ + r
= c + f€
= € + χ

D = R + 2f€
= φ + 4 Σ

D = L — 𝑓
= ∂ — đ
= π — Σ

D = 𝒻 — c
= 𝒮 — 2c
= 𝕊 — 3c
= P — 4c

D = 2 𝒻 — S
= 2𝒮 — P
= 4 𝕊 — 3P
= 3𝒮 — 2𝕊

D = Σ + c + r
= 2Σ + đ + f
= 3Σ + c + f
= 3Σ + R + R

D = 4 Σ + € + f
= 11Σ + χ + m
= 14Σ + f + m

D = 14 d + 43 f — 13m
= φ + f€ — f
= 15Σ + 2 m — F
= c + R — r

D = đ + R — χ
= π + r — χ
= 9Σ + m — f€
= S + Σ — 5 c

D = 𝒻 + Σ — đ
= π + c — đ
= ℰ + f€ — đ
= 𝒮 + χ — 𝒻
= 𝒻 + π — ∂
= S + π — P
= 𝕊 + 𝒻 — P
= L + ∂ — P
= S + f€ — P
= 2c + 2 𝒻 — P
= 6 c + 2 χ — P

D = 2€ + 2 ∂ — P
= 2ℰ + 2 π — P
= 6đ + 2 f — P
= T + χ — t
= 𝕋 + χ — T
= t + 𝒻 — 𝕋
= 2 t + 𝒮 — 2T
= 3 t + 𝕊 — 3T
= 4 t + P — 4T
= T + 𝒻 — 𝕋
= t + 𝒮 — 𝕋

D = 2 đ — R — 4 Σ
= 4 ℰ — 2R — P
= 𝒻 — € — Σ
= 3 𝒻 — χ — P
= 2L — 2€ — P
= 2𝕊 — 2 c — P
= 2 S — 2 𝑓 — P
= t — Ṡ — C

D = t — ℰ — P
= 2t — 2S — P
= 2t — 𝕋 — S
= 3t — 2T — S
= T — 𝑓 — P
= 2T — 𝕊 — P
= 𝕋 — 𝕊 — 3c

DIEZE MINOR of Rameau, has a ratio $\frac{3072}{3125}$ = 15 Σ + f + m, or the HYPEROCHE, which see (*ϱ*)

DIFFERENTIAL CALCULUS. See FLUXIONS.

DIFFERENTIAL THERMOMETER. See CHEMISTRY, vol. vi. p. 152.

DIFFRACTION OF LIGHT. See INFLECTION in the Index of OPTICS.

DIGESTION. See ANATOMY, MEDICINE, and PHYSIOLOGY.

DIGITALIS, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 250.

DIGNE, DINIA, or DIGNA, is an ancient town of France, and principal place of the department of the Lower Alps. It is situated in a fertile valley at the foot of mountains, upon the left bank of the river Bleonne, which is still called *Mardoric*. The principal buildings in the town are the cathedral, five convents, a seminary, a college, and an hospital. This town, however, is chiefly celebrated for its mineral waters and warm baths which are at the distance of about a league. The temperature of the water varies from 30° to 40° of Reaumur. In cases of anchylosis, or stiffness of the joints, produced by gun-shot wounds, it has produced wonderful cures. The mountains in the neighbourhood abound in petrifactions, and the crater of an extinct volcano appears on one of the highest summits. There is here a manufacture of paper, of caps and stockings, and of drabs called kalmoucks; and great quantities of excellent fruits are collected in the adjacent valleys, and are exported to other parts of France, Italy, and Germany. Population of the town 2872. East Long. 6° 14′ 19″, and North Lat. 44° 5′ 18″. (*j*)

DIGYNIA. See BOTANY, p. 73.

DIJON, a town of France, formerly the capital of Burgundy, but now the chief place in the department of the Cote d'Or, and of the 6th cohort of the legion of honour. It is situated in an agreeable and fertile plain, between the rivers Ouche and Suzon, the first of which rises to the south of the town, while the last, which is frequently dry, flows past it on the north. The town is entered by five gates, viz. the Gate of Bourbon, the Gate of St Nicholas, the Gate of William, the Gate of Ouche, and the Gate of St Peter. It has three fauxbourgs, viz. those of St Peter's, of Ouche, and of St Nicholas, which communicated with the Chartreuse, before its destruction, by a long and fine avenue of large trees. The town is of an oval form, its length being 1500 paces, its breadth 1000, and its circumference, without including the suburbs, 1350 toises. The fine walls with which Dijon is surrounded, have half-moons, about 12 bastions, ditches, and a chateau in the form of a citadel. It is of a square shape, with a large round tower at each angle, and is flanked with two *fers a cheval*, one towards the town, and the other towards the country.

Streets and squares.

The streets of Dijon are straight, spacious, and well paved, and the houses are in general handsome and commodious. The Place Royale, now the Place Grande, was formerly decorated with an excellent equestrian statue, in bronze, of Louis XIV. by Le Hongrie, which weighed 52,000 pounds, and cost 108,000 livres, independent of the pedestal, which contained 1295 square feet of marble. The Place is constructed in the form of a horse-shoe, has a circular ballustrade, in the front of which is the magnificent provincial palace, called *Le Logis du Rois*, adorned with superb porticoes, and a very high tower, which has a fine effect. On the left hand is the *Palais des Etats*, and the street of Conde, (afterwards called the street of Equality), consisting of the most splendid houses, uniformly built; and on the right is the high and bold spire of St Chapelle, and the belfry of the cathedral, so as to render the view of the town from this place remarkably grand. The other squares are those of St Stephen, St John, St Michael, and that of the Cordeliers. The public buildings of Dijon are both numerous and elegant.

National Palace.

The Palais du Logis du Roi, now the *Palais National*, was formerly inhabited by the governors of the province, and has often been used by several of the French monarchs. It is surmounted by a large tower, which was begun in 1367, and finished by Philip-le-Bon. It is very high, and of an irregular shape, but has nevertheless a fine effect, and was employed as the observatory of the academy. In this palace, the 6th cohort of the Legion of Honour now hold their sittings. The inside of the square tower was formerly the kitchen of the Prince of Conde; the fire places for roasting are placed all around, with the stove in the middle to let out the smoke. It is now used, says M. Millin, for the preparation of soup a la Rumford. A few chambers of the ancient palace are all that remains.

Museum.

In one of the wings of this building is the museum of Dijon, which owes its establishment to the zeal of M. Desvoges, who first proposed it to the states of Burgundy. The room for study is large, and well suited to the purpose of drawing from engravings, busts, and models. In 1805, there were 150 students. Formerly they received prizes, and those who had this honour were sent to Rome. There are several rooms full of pictures, marble statues, and other curiosities. The room which contains engravings is very light, and is furnished with desks facing the windows: The number of engravings is 40,000. The rooms are open to the public every Sunday from twelve till two o'clock in winter, and from two till four in summer.

Parliament house.

The palace where the parliament of Dijon formerly assembled, is also worthy of attention. Its porch is adorned with columns and statues, particularly one of Henry II. in whose reign the great hall and the portal were begun. They were finished by Charles IV. The Hall of Public Audience was erected by Louis XII. The ceiling is extremely rich with gilding, sculpture, and painting. The painted glass which forms the windows, was a present from Francis I.

College.

The college of Dijon has always been reckoned one of the best regulated in France. Here are professorships of theology, philosophy, mathematics, the German language, history, rhetoric, eloquence, poetry, and humanity. Every three years, prizes, which were founded in 1737 by the first president, Jean de Berbisey, to the amount of 1000 livres, are regularly distributed. It has also a library and a physical cabinet.

Academy.

The academy of Dijon has been celebrated for having crowned an eloquent discourse of Rousseau's. It was founded in 1725, and has for its objects, morals, physics, medicine, belles lettres, and the arts. It holds its sittings in a magnificent saloon, adorned with the portraits of eminent men. An annual sum of 1800 livres was given by the states of the province to the academy, for the purpose of founding a public and gratuitous lecture on chemistry. Lectures are also given on materia medica, botany, philosophy, and anatomy. Attached to it is the botanic garden, situated a little to the east of the town. It was given to the academy by M. Legouz de Gerlan, who died in 1774. When the church of St Magdalen was demolished at the revolution, his remains were deposited in a black sarcophagus, and placed upon a base under the trees, at the extremity of the garden. Besides the botanic garden, this academy has a collection of natural history, a chemical laboratory, a medaillery, and an observatory.

Church of St Benigne.

The church of the abbey of St Benigne was consecrated in 535; but the present church was finished in 1288. It is reckoned one of the largest and most elegant in the kingdom, and deserves particular notice. The body of the church is 213 feet long over the walls, and 87 wide, 42 of which are occupied with the great nave, and it is 92 feet high under the roof. The spire, which is particularly admired, has only a small diameter, but rises to the height of 375 feet. The height of the cross is 36 feet, and the spire is furnished with a conductor. The front is ornamented with two similar towers, about 240 feet high, in one of which are two bells, one of 11 and the other of 15 thousand pounds weight. The organ is esteemed one of the finest in the kingdom. Behind the choir of this church are the ruins of a Pagan temple. It is an ancient rotunda, with three arches, one above the other, having a circular opening in the middle, and sustained by 104 columns, having their shafts of one stone. Nearly a third of this edifice is under ground.

Church of the holy chapel.

The collegiate church of St^e^ Chapelle, or the holy chapel, was founded by the dukes of Burgundy, in 1172. The body, which is of a moderate size, and of fine Gothic architecture, is about 167 feet long, 63½ feet wide without comprehending the collateral chapels, and 74 feet high under the roof. It is surmounted with a superb spire, about 350 feet high, reckoning from the pavement of the church. It contains a bell of alloyed silver, and the tower on the front has a fine chime of bells. The statues and paintings, and the miraculous host, which has been preserved in this church for several centuries, are the other objects in it which deserve notice.

Church of St Michael.

The church of St Michael is particularly remarkable for the richness and magnificence of its front, the principal features of which are two similar towers, formed of different orders of architecture, one above the other, and surmounted by two octagonal cupolas, terminated by balls of gilt brass. This building, is not of the Gothic style, like the other contemporaneous edifices, but is a striking example of good taste, at a time when the Greek architecture was despised. This church is 88 feet long over the walls, 89 wide, independent of the side chapels, and 64 high under the roof.

Church of St Stephen.

The church of St Stephen, now the cathedral church, was formerly an abbey, of the order of St Augustine.

Dijon. It was founded in the 12th century. In 1613, it was created into a collegiate church, and in 1731 it became the cathedral. It is 191 feet long, 56 wide, and 48 high under the roof. It is surmounted with a very fine belfry, covered with lead, and having a large bell and a chime; and the front of the church is of modern architecture, from the designs of a pupil of Mansard. It is adorned with a large bas relief of the famous Bouchardon, representing the martyrdom of St Stephen. This church contains several statues, paintings, and relics.

Church of St John. The collegiate church of St John is built in the form of a cross. It is 168 feet long, and as many broad. The spire, which is about 330 feet high above the pavement of the church, is greatly admired. The church is adorned with one large painting by Revel.

Church of Notre Dame. The church of Notre Dame is esteemed one of the most perfect models of Gothic architecture in Europe. It was built in the 13th century. The galleries are formed of small pillars of one piece, six inches in diameter, and from fifteen to thirty feet high. The roof is a piece of exquisite workmanship, and the front is truly magnificent. During the fury of the revolution, however, the statues in the pedentives were broken to pieces. M. Vauban was so struck with the perfection of this building, that he exclaimed that nothing was wanting but a box to preserve it in. The archives of the town are preserved in one of the towers, and upon the other tower, in the front of the church, is a clock with moving figures, which Philip the Bold, Duke of Burgundy, transported to Dijon, after the sack of Courtray.

The church of the Bernardines possesses a fine rotunda, terminated by a ball of gilt copper, and the principal altars are adorned with an excellent painting by J. B. Corneille.

Besides the churches which we have described, there are several others, and a great number of convents, which we cannot afford room to describe.

Chartreuse. The chartreuse, which was at the distance of a quarter of a league from the town, was founded in 1383. The monuments of Philip the Bold, of John the Fearless, and his Duchess Margaret of Bavaria, were of Parian marble, and were esteemed the finest productions of the arts. The figures reposed on superb tables of black marble, and at each tomb were two angels supporting the helmets of the dukes. Of these splendid monuments, a few mutilated fragments and figures only remain, to testify the loss which the arts sustained by the disorders of the revolution. The plough-share has now passed over a great part of the monastery which contained them.

The great hospital, called Notre Dame de la Charite, is deemed one of the finest establishments in France; ornament and utility being equally consulted by the architect. Besides this, there is the hospital of St Anne, and several other charitable institutions.

The promenades of Dijon are numerous and elegant. The ramparts, which encircle the city, afford more than an hour's walk, and command a view of the summit of Mont Blanc and Mont Gemni. The gardens of Montmusard, which are laid out in the English style, and the park which formerly belonged to the prince of Conde, are the most spacious. After the revolution, the city of Dijon purchased it for a public promenade, and laid it out in regular straight walks, from plans by Le Nostre. The river Ouche runs at one end of it. The Arquebuse, which was formerly the place of exercise for the cross-bow company, has been converted into an agreeable rural house of entertainment. It is a small house with a pleasant garden, planted in the English manner, and the ground floor forms a covered gallery, where the company can retire during rain.

Several fine pieces of antiquity have been found in Dijon. In the garden of the house of M. Richard de Veorottes, is a wall in which are preserved forty-two monuments of antiquity, which have been found in the city. In the middle of the wall is a black marble tablet, with the following inscription in letters of gold: Antiquities.

HÆC VETERUM MONUMENTORUM FRAGMENTA E RUDERIBUS PRIMÆVÆ URBIS DIVIONENSIS JUXTA TEMPLUM DIVI STEPHANI FELICITER ERUTA AD PUBLICAM UTILITATEM ET HORTORUM ORNAMENTUM ÆGIDIUS GERMANUS RICHARD DE RUFFEY IN SUPREMA RATIONUM BURGUNDIÆ CURIA PRÆSES EMERITUS SERVANDA CURAVIT. ANNO M.DCCLXXXI. An account of these monuments has been given by the celebrated antiquarian Millin, in the ninth chapter of his Travels.

The principal manufactures of Dijon are woollen stuffs, serges, calmouks, hosiery goods, playing cards, leather, pottery ware, wax candles, hats, and silk stockings. There is also a cotton manufactory, and an extensive nursery. Manufactures.

Dijon carries on a considerable trade in corn, cattle, and wine, which is sent to Paris, Strasbourg, Holland, and Switzerland, and it will be greatly facilitated by the new canal from St Jean de Losne to Dijon. It was unfinished in 1805, five sluices being wanting. It appears, however, to have been lately finished, and the branch from Dijon to St Florentin is now cutting. The fairs, which continue eight days, are held on the 10th March, the 10th June, and the 10th November. Population 22,000. East Long. 5° 2′ 5″, and North Lat. 47° 19′ 25″, by trigonometrical operations. See Montfaucon's *Antiquit. Expliq.* tom. iii. p. 240. for an engraving of the Diptic of Dijon, which is now in the museum; *Journal des Batimens et des Arts.* No. 110. and 112; Reichard's *Guide des Voyageurs en France*; Millin's *Travels through the Southern Departments of France,* chap. viii, ix; Lemaistre's *Travels,* vol. i; Herbin *Statistique de France*; and Tynna's *Almanac du Commerce,* pour 1811. (π) Commerce.

DILATATION. See EXPANSION.

DILATRIS, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 96.

DILIVARIA, a genus of plants of the class Didynamia, and order Angiospermia. See Brown's *Prodrom. Plant. Nov. Holl. &c.* p. 480, and BOTANY, p. 259.

DILLENIA, a genus of plants of the class Polyandria, and order Polygynia. See BOTANY, p. 240.

DILLENIUS, JOHN JAMES, a distinguished botanist, in the early part of the eighteenth century, was born at Darmstadt, in Germany, in 1687. While prosecuting his medical studies at the University of Giessen, in Upper Hessia, he shewed his predilection for botanical pursuits. Of six communications which he presented to the Imperial German Academy, and which are printed in their *Miscellanea Curiosa,* no fewer than five treated of subjects connected with botany; and in 1719, he published, in octavo, a List of the Plants indigenous to the neighbourhood of Giessen, illustrated by some figures of his own engraving.

Sherard, the enlightened and liberal British consul at Smyrna, having recently before returned home, had his attention drawn towards Dillenius by the publication of this local Flora; and in 1721, prevailed on him to remove to England, and settle in London.

In this country Dillenius first brought himself into notice, by publishing an improved edition of the *Synopsis Stirpium* of the illustrious Ray. Here he discovered his partiality to the investigation of the tribes of minute plants, now known by the general title of Cryptogamia; particularly the Musci, which he first subdivided into the well-known genera Bryum, Hypnum, Minum, &c. He added twenty-four figures of rare plants, drawn and etched by himself. This edition of the Synopsis continued to be the principal guide to English botany, till the publication of Hudson's *Flora Anglica*; which again was in some measure superseded by Withering's *Arrangement*; while this last has been succeeded by Smith's *Flora Britannica*, a work the most perfect of its kind that has appeared in any country. The Dillenian edition of Ray's Synopsis, is still held in esteem by botanists, and has now become a very scarce book.

The consul Sherard already mentioned, who died in 1728, having left a considerable sum of money towards endowing a botanical professorship at Oxford, on condition that Dillenius should be the first professor; this appointment was accordingly carried into effect, and Dillenius was enabled to dedicate the rest of his life exclusively to botanical pursuits. The real object of the founder was the continuation of Caspar Bauhin's *Pinax*; a work in which he himself had laboured for some years. To this duty of the Sherardian professor, Linnæus long afterwards alluded, in dedicating to him his *Critica Botanica*; but the continuation of the Pinax, although understood to be in an advanced state of preparation, never was given to the public, owing entirely to the expence exceeding the means of Dillenius.

Dr Sherard, the brother of the consul, possessing an excellent botanic garden at Eltham, about eight miles from London, Dillenius, while resident in the capital, had been a frequent visitant; and had been led to undertake the describing and figuring of the plants in this collection. After many years labour, the *Hortus Elthamensis* came out in 1732, in two large volumes folio. In this splendid book, 417 plants are described and figured; and, as usual, the figures were not only drawn, but etched by Dillenius himself. While these engravings are certainly not to be compared with the matchless productions of Bauer and Hooker, in our days, they must be admitted to possess very great merit; and it was not without reason, that Linnæus pronounced the book, at the time of its publication, to be "*opus botanicum quo absolutius mundum non vidit.*"

In 1736, the Swedish naturalist paid a visit to Dillenius at Oxford. He was not able to persuade the Professor to renounce the method of Ray, and adopt his sexual system; but these great botanists agreed so well, that Dillenius was even desirous to associate Linnæus with him in his labours,—a plan, which, it is said, failed, through the opposition, or at least the indifference, of Sir Hans Sloane.

About this time, Dillenius assisted the learned orientalist Dr Shaw, in describing and figuring the new or rare plants which he had collected abroad; and the *Specimen Phytographiæ Africanæ*, subjoined to the Doctor's Travels in Barbary and the Levant, may be considered as the work of Dillenius.

For many years, Dillenius had attached himself principally to the investigation of the great family of the Mosses, including under this title not only the frondose mosses, but jungermanniæ, lichens, confervæ, byssi, and others. In 1741, he brought out, in one large volume 4to, illustrated with 85 plates, his *Historia Muscorum*. In this admirable work he describes and gives representations of about 600 species, many of them before unknown or undistinguished. By this treatise, the fame of Dillenius was firmly established. The perspicuity of his descriptions, and the general accuracy of his figures, have ensured him the praises of all succeeding botanical writers. Willdenow pronounces it an "incomparable work." When Linnæus afterwards published his System, he did little more, in the families of Mosses and Lichens, than arrange the Dillenian species, and reduce the copious specific characters into his own short and technical style. Both Dillenius and Linnæus, it may be remarked, were in the dark as to the nature of the fructification of the *musci frondosi*, which was first discovered by the celebrated Hedwig. But while Hedwig has illustrated the musci, and Acharius the lichens, the *Historia* of Dillenius continues to be a standard work of reference to this day. No more than 250 copies were printed; and yet so limited was the demand at first, that the author was a considerable loser by the publication. In less than thirty years, however, it became a rare book. In 1763, the plates were republished without the letter-press; and from this time a copy of the original edition, with the letter-press, bore the most extravagant price.

In 1811, a new edition of this splendid and expensive book was undertaken at the University press of Edinburgh, by Mr Charles Stewart,—a gentleman who has been long known as a keen naturalist, and as the author of an excellent elementary book, entitled, *Elements of Natural History*, published at Edinburgh in 1801. In order to save the original copy from being soiled in the course of reprinting, it was enclosed in a glass case, which was unlocked only when the compositor needed to turn a leaf. This new edition was printed page for page with the original, so that the references of authors might apply to it. No freedom whatever was taken with the original, except correcting some typographical errors which had escaped the author. Even the spelling of his English words was respected. To the synonymes given by Dillenius himself, Mr Stewart has very properly added, in an appendix, a list of modern synonymes. The plates were re-engraved with great care, the original plates having been destroyed many years ago. The whole work is in a style of elegance highly creditable to the Edinburgh press.

After his publication on Mosses, Dillenius, it is understood, turned his attention particularly to the illustration of English *fungi*, of many of which he prepared drawings and descriptions; but these he did not live to publish. He was of a corpulent habit, and was cut off by apoplexy in 1747, in his 60th year. A portrait of him is preserved at Oxford, but no tombstone marks his place of sepulture, the only monument to his memory being one strictly botanical,—the naming after him, by his friend Linnæus, of a genus (*Dillenia*), including several lofty and beautiful Asiatic trees. See Pulteney's *Sketches of the Progress of Botany*, vol. ii.; and *Biog. Brit. in loco*. (P. N.)

DILLINGEN, a town of Germany, in the kingdom of Bavaria. It was formerly in the circle of Suabia, and was the ordinary place of residence of the Prince Bishop of Augsburg, to whom it belonged.

It is situated on the Danube, and contains an episcopal palace, a Catholic university founded in 1552, a college of secular canons, a convent of capuchins, and two convents of religious. It is 12 miles north west of Augsburg. East Long. 10° 20′ 29″, and North Lat. 48° 34′ 17″, according to trigonometrical observations. (*j*)

DILLWYNIA, or ROTHIA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 286.

DIMERIA, a genus of plants of the class Triandria, and order Digynia. See Brown's *Prodromus Plant. Nov. Holl. et Ins. Van Diemen*, p. 204; and BOTANY, p. 116.

DIMINISHED INTERVALS, in Music, according to our nomenclature of this science, are any such intervals as are less than their true quantity, by the semi-tone minor or S, ($=36\Sigma+f+3m$,) and in like manner we call all intervals which are greater than their true quantity by S, *superfluous* intervals, whether the same are major or minor consonances, in either case. See the list of sixty notes on Mr Liston's organ, in the *Phil. Mag.* vol. xxxvii. p. 276. In speaking of regularly tempered scales, Dr R. Smith in his *Harmonics*, second edition, p. 165, says, "The interval of a minor consonance augmented by a minor limma, (*l*, see our articles DIESIS and LIMMA *of Tempered Scales*,) makes the interval of a *superfluous* consonance; and the interval of a minor consonance diminished by a minor limma, makes the interval of a *diminished* consonance."

If we examine Mr Liston's untempered or perfect diatonic scale of the octave C*c*, in p. 12, of his *Essay on perfect Intonation*, we shall find, that the *sharps* and the *flats* are in every case but one, applied to *major* intervals, (above C,) as I, II, III, &c.; and this exception occurs with F, the *minor* fourth or fourth of this key: this respects the giving of names to the notes or sounds. Mr Liston's restriction of ※'s to major intervals, and ♭'s to minor intervals, and so applying his terms *redundant*, (instead of *superfluous*,) and *diminished*, when treating of intervals generally in pages 115 and 137, however sufficient and well adapted the same may be to the purposes of the practical musician, seem wanting in that precision and method, which the subject is now capable of receiving in an elementary work.

If the term superfluous, (or redundant,) had been limited by Mr Liston to the quantity S, and also the term dimished to the same quantity, as has been mentioned above; and the marks ※ and ♭, when thus used to describe *intervals*, without reference to their place on the staff, or as marking particular *notes*, had also been restricted to S; and when such *intervals* required to be named or marked, as occur upon C, E, and A, and below E♭ and A♭, vulgarly called their sharps and flats, (see *Phil. Mag.* vol. xxxix. p. 275,) but which are, in reality, each equal to the semi-tone medius 𝕊, ($47\Sigma+f+4m$,) or S+*c* instead of S, the same had been called *acute-superfluous*, and marked ※', and *grave-diminished*, and marked ♭', a very considerable improvement would have been made in this truly valuable Essay, by avoiding all ambiguity. In tempered scales these distinctions do not apply, and ※$=l$, and ♭$=l$, in all cases, as Dr Smith remarks above: but for perfect instruments, and even for voices, C※', E※', and A※' and E♭♭', and A♭♭' had better be marked at the beginning of the staff, and wherever ※ and ♭ occur to these notes respectively; and then ※ and ♭ would, in every case, denote the interval S, or minor semitone. But at any rate, when treating of *intervals* and chords, without reference to the particular *notes* which form them, these distinctions ought not in future to be omitted, and ※ and ♭ sometimes be used to signify S, and sometimes 𝕊, as Mr Liston has unfortunately done, instead of writing ※'I, ※'III, and ※'VI; and ♭'3, and ♭'6; or he should have abstained altogether from the use of the marks ※ and ♭, when not used with reference to those at the cliff, (as observed by him at page 49,) and have used some other marks, attached to the numerals of the intervals, correctly defining the distinction between S and 𝕊, in the cases above referred to.

The analogy with the terms *major* and *minor*, to which Mr Liston refers in p. 137, in excuse for the ambiguity above complained of, cannot avail; for although practical musicians often say, "a flat third," and in works on thorough bass, &c. write ♭3 and ♭6, when they mean the minor third and minor sixth, and "sharp third" and "sharp sixth," when they mean the major third and major sixth, &c.; yet what theoretic writer, or indeed any other, writes ♭III for 3rd ($=161\Sigma+3f+14m$), or ※3rd for III ($=197\Sigma+4f+17m$), or ♭VI for 6th ($=415\Sigma+8f+36m$), or ※6 for VI ($=451\Sigma+9f+39m$), &c.: and yet we may tolerate and safely use E♭ and A♭ to designate the notes answering to the 3rd and the 6th of the key C, &c. as mere *names for these notes*, and without reference to their exact distance from any others in the scale, although we consider these notes, the 3rd and 6th and others, as equally *determined by nature*, and their place in the scale fixed with the same mathematical accuracy as the III. and VI. from which certain writers, during the infancy of the science, as to correct theory, happened to derive the former, and to name them accordingly: but in speaking of *the intervals between notes*, terms and marks that are definite and unvarying in their meaning, ought alone to be tolerated or used by theoretic writers of the present day, when mathematical accuracy can and ought to be given to every expression relating to musical intervals, as we are taking so much pains to shew in this department of our work.

Mr Maxwell, in his "*Essay upon Tune*," p. 51, &c. contends for and uses the words and marks sharp and flat and ※ and ♭, in one invariable sense as to magnitude, but he unfortunately fixed on 𝕊 ($=47\Sigma+f+4m$) for the same, instead of 𝒮 ($=36\Sigma+f+3m$), although the former occurs in practice only half as frequently as the latter. See *Phil. Mag.* vol. xxxix. p. 375.

We shall mention below, the intervals in alphabetical order, major and minor, to which we have seen the term *diminished* prefixed, using the numerals and symbols of our XXXth Plate, Vol. II. but omitting the cols. f and m, in order to shorten the detail; and only mention the Σ s, which then are the *artificial commas* of Farey, viz.

DIMINISHED *Eighth*, major, VIII—$\mathcal{S}=576\Sigma$; minor, 8—$\mathcal{S}=529\Sigma$.

DIMINISHED *Fifth*, major, V—$\mathbb{S}=311\Sigma$, and V—$\mathcal{S}=322\Sigma$; minor, 5—$\mathcal{S}=322\Sigma$.

DIMINISHED *Fourth*, major, IV—$\mathcal{S}=265\Sigma$; minor, 4—$\mathbb{S}=207\Sigma$, 4—$\mathcal{S}=218\Sigma$.

DIMINISHED *Fourth* of Bemitzrieder, has a ratio $\frac{6561}{8192}$, $=196\Sigma+4f+17m$, and its log. =.9035800,9412; the true minor fourth exceeds this interval by the apotome, or it is 4—P. See FOURTH *Minor*.

DIMINISHED *Second*, major, II—$\mathbb{S}=57\Sigma$, and II—$\mathcal{S}=68\Sigma$; minor, 2—$\mathbb{S}=10\Sigma$, and 2—$\mathcal{S}=21\Sigma$.

DIMINISHED *Seventh*, major, VII—$\mathcal{S}=519\Sigma$; minor, 7—$\mathbb{S}=461\Sigma$, and 7—$\mathcal{S}=472\Sigma$.

DIMINISHED *Seventh* of Calcott and Marsh, and greater diminished seventh of Chambers; it is equal to three minor thirds, has a ratio $\frac{125}{216}$, $=483\Sigma+9f+42m$, and its log. =.7624562,6185: the true minor seventh exceeds this interval by the semitone subminimis, or it is 7—f, or 7'—$\mathcal{S}$. But it seems probable, from comparing pages 164 and 202 of Dr Calcott's *Musical Grammar*, 1st edition, that in the latter page the Doctor has omitted the word "extreme," or "double," before

Diminished Intervals ‖ Dinant.

diminished, (see EXTREME *Diminished Intervals*), and that he intended to compare this interval 3-3rds, with the major seventh, because it is equal to $VII-2\mathcal{S}$, or the double diminished major seventh. See SEVENTH.

DIMINISHED *Sixth*, major, $VI-\mathcal{S}=415\Sigma$; minor, $6-\mathfrak{S}=368\Sigma$, and $6-\mathcal{S}=379\Sigma$.

DIMINISHED *Third*, major, $III-\mathcal{S}=161\Sigma$; minor $3-\mathfrak{S}=114\Sigma$, and $3-\mathcal{S}=125\Sigma$.

DIMINISHED *Third* of Bemitzrieder, or the double limma, (2 L) has a ratio $\frac{59049}{65536}$, $=92\Sigma+2f+8m$, and its log. $=.9547326,1658$: the true minor third exceeds this interval by $69\Sigma+f+6m$, or $2L=3-\mathfrak{S}-\Sigma$.

Dinapore ‖ Dingle.

DIMINISHED *Seventh, Chord of*, consists, according to Mr Liston's *Essay on perfect Intonation*, p. 90, of three minor thirds, the middlemost of which is grave, or a common deficient minor third, and this chord is thus represented by him in numerals, and by us in artificial commas, viz.

♭7		472		VI		451		VI′		462		VI		451
5	or	311,	and its inversions are	5	or	311,	or	IV	or	301,	and	IV	or	301.
3		161		3′		150		3		161		※II		140

DIMINISHED, *Double or Extreme, Intervals*, are such as are lessened two minor semitones, or $2\mathcal{S}$ $(=72\Sigma+2f+6m)$, according to our nomenclature; but it is not uncommon to meet in musical writings with intervals so called, which are lessened a minor and a medius semitone, or $\mathcal{S}+\mathfrak{S}$ $(=83\Sigma+2f+7m)$. See EXTREME *Diminished Intervals*. (ϱ)

DIMOCARPUS, a genus of plants of the class Octandria, and order Monogynia. See BOTANY, p. 199.

DIMON, Greater and Lesser. See FAROE ISLES.

DIMORPHA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 281.

DINAN, a town of France, in the department of the Cotes du Nord, and chief place of the arrondissement of the same name. It is situated near the left bank of the river Rance, and has a small harbour, and a communication with St Malo. It has a fine chateau, two convents, and an excellent hospital. Several manufactures are carried on in Dinan, the principal of which are those of linen cloths, flannel, drabs, ribbands, and leather. Twelve thousand pieces, of 100 ells each, of linen cloth, were manufactured annually.

This town, however, is chiefly celebrated for its mineral waters, which are much frequented by strangers. According to the experiments of M. Monnet, who analyzed the water in 1769, it contains carbonate of iron, and muriate of soda. Its taste is ferruginous. Though pellucid when it issues from the spring, yet if left exposed to the air, it becomes turbid, and deposits an ochreous sediment at the bottom of the vessel. It then loses its metallic taste, and becomes insipid. It acts as an aperient, a detergent, an astringent, and a tonic; and is particularly recommended in cases of deficient or superabundant menstruation. There is a society of agriculture at Dinan, and the surrounding country produces abundance of corn, hemp, and flax. A considerable trade is carried on in butter, flax, honey, and tallow. A fair, called *Le Liege*, is held on the second Tuesday of Lent. It lasts eight days, and there are sold at it horses, cattle, jewellery, and haberdashery goods. Population 4200. West. Long. 1° 59′, North Lat. 48° 27′ 16″. (*j*)

DINANT, a town of France, in the department of the Sambre and the Meuse, and chief place of the arrondissement of the same name. It is situated on the right bank of the Meuse, between a steep rock and the river. The chief buildings are a collegiate church, and seven other churches which are annexed to it; a college, six convents, and two hospitals. It had formerly a castle, and was well fortified, but the fortifications were demolished in 1703. Dinant has long been celebrated for its manufacture of braziery goods, which have received the name of *Dinanderie*, of which considerable quantities are sent to almost every part of Europe. Its tanners are also famous, and many skins are exported. It has also manufactories of cards and paper, and a refinery of sugar. In the neighbourhood are veins of black, white, and red marble, and other stones, out of which works and utensils of all kinds are continually sent to Holland and Westphalia. There are likewise rich mines of iron in the neighbourhood. Population 2964. (*j*)

DINAPORE, a town of Hindostan, in the district of Patna and province of Bahar, remarkable for the elegant and magnificent military cantonment erected by the East India Company. The accommodation enjoyed by the officers and soldiers is much more extensive than in the best English barracks, and the apartments are spacious and well-aired. The troops belonging to the native battalions are lodged in small tents, a little inferior to those of the natives. Bread, and every article of food, is here remarkably cheap. See Tennant's *Indian Recreations*, vol. ii. (*j*)

DINAS-MOWDDWY, or DINASMOWTHY, is a village of North Wales, in the county of Monmouth, placed at the junction of three vallies on the shelf of a precipice, called Craig-y-Dinas. It is delightfully situated near the small river Cerris, at its junction with the Dovey or Dyfi. The road winds circularly round the declivity of the mountain; and as the streets have a similar curve, the village appears from a distance as if suspended on the side of a mountain. The buildings are mud cottages, one story high, and covered with rushes. There is a good bridge over the river, and the church is more than a mile from the village.

This place was formerly of considerable consequence. It was a fortified city, and the residence of a chieftain, and possessed very extensive privileges, till the reign of Henry VIII. when the laws of England were extended to Wales. The corporation consists of a mayor, alderman, recorder, and several burgesses. The mayor possesses the right of trying criminals, though he has not exercised this privilege for several years. The mayor and aldermen are justices of the peace within their little district, and they have the exclusive power of granting licences to victuallers. In the absence of the lord of the manor, the recorder hears and determines causes of debt not exceeding forty shillings sterling.

The number of houses in this village and the parish of Llan Mowddy, is 45, and the number of inhabitants about 225. There are three annual fairs in the village, and well supplied markets on Friday. See Pennant's *Tour in Wales*, vol.ii.; Evans' *Tour through North Wales*; and Evans' *Beauties of England and Wales*, vol.xvii. p. 919. (*j*)

DINGLE, or DINGLE-I-COUCH, a market and post town of Ireland, in the county of Kerry. It is situated on the north side of Castlemain Bay, and has a harbour about a quarter of a mile broad at its mouth, but wider within, so as to shelter ships from all winds. Vessels of 100 tons can come up to the town. Many of the houses are built in the Spanish style, with ranges of stone balcony windows, owing to several Spanish merchants having resided here before the time of Queen Elizabeth. In the neighbourhood of Dingle, a strong linen fabric is made under the name of *box* and *trap*. "Towards Dingle," says Mr Wakefield, "the linen manufactured is 3-4ths wide, and sells for 1s. and 1d. per yard. Every family of all classes sow their own flax. In gentlemen's houses, the women servants spin it, and it is given out to be wove. Except table linen, every thing is manufactured at home." This town exports butter and other articles of provisions. It was once a borough, but lost its privileges at the union. See Smith's *Account of Kerry;* and Wakefield's *Acccount of Ireland, Statistical and Political,* vol. i. p. 690. (π)

DINGWALL. See Ross-Shire.

DINKELSBUHL, or Dunkelsbuhl, Tricollis, Zeacollis, or Zeapolis, is an ancient town of Germany, situated on three hills upon the river Wernitz. It was once a free and imperial city, but at the treaty of Luneville it was given to Bavaria as a part of her indemnities, for what she ceded on the Western bank of the Rhine. The chief altar of the church of the Carmes is adorned with a very fine painting. The principal manufactures are those of woollen goods, shoes, hats, stockings, fustians, and beer. The cheese of this town is much admired. The inhabitants, half of whom are Lutherans and the other half Catholics, amount to 6500. (*j*)

DINKIRA, a country of Africa in the interior of the Gold Coast. It is distant about 10 days journey from Axim on the coast, and about 5 from Mina or Elmina. It is bounded by Kabesterra on the east, Adom on the west, and Achen on the north. The roads from Axim and Mina are extremely bad, though with very little labour they might be greatly improved and shortened. The Dinkirese are said to have much gold, which they obtain partly from their own mines, partly by pillage, but chiefly from commerce, which they understand better than the other negroes. When the roads are open, the Dinkirese and the Achenese merchants frequent the markets of Schama, Axim, Commendo, Mina, and Cape Coast; but when the roads are shut up, they go to the more distant parts of the coast. The gold of this district is very fine, but is often mixed with the gold of Fetiche. (*j*)

DIOCLESIAN, or Diocletian, the forty-second emperor of Rome, was born A. D. 245, at Doclea or Dioclea, in the country of Dalmatia; and, from the place of his nativity, he bore originally the name of Diocles, which he afterwards extended, by a Roman termination, into Dioclesianus. His father was at one time a slave, but afterwards obtained his freedom, and appears to have raised himself at length to the office of a notary or scribe. Dioclesian entered the army at an early age, and, while he yet held the station only of a common soldier, had his ambition remarkably excited by the speech of a druidess at Tongres, in France, in whose house he chanced to lodge; and who, in settling his daily charges, was provoked, on one occasion, by his miserly disposition, to reproach him with covetousness. "As a poor soldier," he replied, "I must exercise œconomy; but I shall be more generous when I am emperor." "Do not," said the druidess, "treat these words as a joke; for, assuredly, you shall become emperor, after having slain a wild boar." From that moment he conceived the most aspiring hopes, and secretly imparted his expectations to his friend Maximian. Mindful of the prediction of his hostess, he was perpetually aiming at its accomplishment, by seizing every opportunity, in hunting and putting to death wild boars with his own hand; and, as he saw the imperial authority passing successively through the hands of Aurelian, Tacitus, Probus, Carus, and Numerian, he used to say sportingly to his friend, "I always kill the boars, but others eat the venison." He pursued, however, a surer road to the attainment of his object, by studying to excel in the military art; and soon became so eminent in his profession, as to be generally ranked among the number of excellent commanders, who were formed under the discipline of Probus. He distinguished himself so much in the expedition of Carus against the Persians; that he was promoted to the consulship, and, at the time of Numerian's death, he held the command of the imperial guards. This was a station, from which more than one of his predecessors had stepped into the throne; and, as soon as the death of Numerian was known, he was unanimously proclaimed emperor, by the army, at Chalcedon, A. D. 284. Instantly ascending the tribunal, he solemnly assured the soldiers with an oath, that he was in no respect accessory to the removal of their late sovereign; summoned the actual murderer Arrius Aper into his presence; and, charging him with the atrocity of his crime, plunged his sword into his breast. To this summary punishment of the assassin, with his own hand, he is supposed to have been impelled by a desire to fulfil the words of the druidess; and is said to have exclaimed, upon beholding Aper fall, "Now, at last, I have killed the fatal boar!" * After making his public entry into Nicomedia, in the character of emperor, he prepared to meet Carinus, the brother of Numerian, who was advancing from Gaul, with a powerful army to contest the succession. Several bloody battles were fought in Illyricum, between these two competitors, in one of which, in Upper Mœsia, Dioclesian was entirely defeated; but Carinus, who was detested for his debaucheries, was slain while pursuing his adversary, by a tribune of his own army, whose wife he had seduced; or, as Eutropius relates, was betrayed by his soldiers, and put to death by the command of Dioclesian. Being now sole master of the empire, he marched to Rome, for the purpose of establishing his authority; and completely gained the esteem of his subjects, by the generosity which he displayed towards those who had supported Carinus, and by the purpose which he professed of making the emperor Antoninus his model. He soon after set out for Germany, where he gained some advantages over the Allemanni; and his generals in Britain having likewise proved successful, in the field, he assumed, upon these grounds, the surnames of Germanicus and Britannicus. Being threatened, however, by several pretenders in Gaul, and having in his own disposition a greater portion of the statesman than of the warrior, he began to experience the want of a more warlike assistant; and, as he had no male issue, for whom he might have wished to secure the succession, he chose as his associate in the empire, A. D. 286, Marcus Aurelius Valerius Maximian, whose personal attachment he had long and fully experienced, and who united the most undaunted courage, with the most eminent military talents. Reserving to himself the eastern

* The word *Aper* signifies a *wild boar.*

provinces, he allotted to his colleague the more western countries, Italy, Africa, and Spain. He assumed also the title of Jovius, while Maximian took that of Herculeus; and they continued to preserve, upon the throne, the same steady friendship which they had long cherished in a private station. His more warlike associate respected the superior intellect of his patron, who knew well, on his part, how to employ the stern bravery of the other, as a ready instrument in executing the severer measures of government. Proceeding to their respective regions, Dioclesian, by the mere terror of his preparations, compelled the Persian king to restore Mesopotamia, which he had wrested by surprise from the empire; and gained various successes over the Saracens and Goths, in Pannonia. Maximian, in the west, was not less prosperous, routing the Germans and other barbarous nations, wherever they ventured to wait his approach. For these successes they obtained a triumph, and afterwards proceeded in different directions, in the depth of winter, to hold a friendly conference at Milan, A. D. 290; a meeting, it is conjectured, which had no other object than merely to manifest the cordial union which subsisted between them, and thus indirectly to secure the tranquillity of their dominions. Two years after this event, they found sufficient occasion for all their united wisdom and courage; and were barely competent to preserve the empire amidst the host of enemies, both foreign and domestic, by whom it was assailed. Carausius, a famous sea captain, still held the sway in Britain, of which he had taken possession several years before. The Persian king broke into Mesopotamia, threatening to overrun all Syria; while five confederated nations were desolating the provinces of Africa. Aurelius Julianus had caused himself to be proclaimed emperor in Italy; and Achilleus assumed the same title in Egypt. In order to make head against these accumulating dangers, the two emperors formed the resolution of choosing two approved generals, who should bear the title of Cæsar, and succeed them in the administration of the empire. In this view, Dioclesian made choice of Galerius, who was surnamed Armentarius from his original occupation of a herdsman; and Maximian selected Constantius, whose pale complexion had procured him the appellation of Chlorus. That this union of power might be cemented as firmly as possible, the two elected princes were obliged to enter into an alliance with the imperial families, Galerius espousing Valeria the daughter of Dioclesian, and Constantius taking to wife Theodora, daughter-in-law of Maximian. A new division of the empire followed this arrangement. Dioclesian chose for himself the rich countries of Asia to the east of the Egean Sea; and allotted to Galerius the regions of Thrace and Illyricum. Maximian held Italy and Africa, with the adjoining islands; and Constantius was charged with the defence of Gaul, Britain, and Spain. Each of them reigned as an absolute sovereign in his respective district, but all harmoniously concurred in the enactment of laws, applicable to the whole empire, and always paid great deference to Dioclesian, as their common father and benefactor. Many inconveniences, however, attended this plurality of sovereigns, especially the multiplicity of civil and military offices, which were necessarily required by four distinct courts; and the additional load of taxes for their support, which reduced many provinces of the empire to the greatest misery.

Dioclesian, thus supported by new associates, proceeded to Egypt, where Achilleus had usurped the sovereignty; and having compelled him, after a siege of eight months, to surrender the city of Alexandria, he exercised the most cruel vengeance upon the inhabitants, and also upon those of Busiris, Coptus, and the other principal Egyptian towns. Hence he passed to Antioch, A. D. 296, in order to superintend the operations of the Roman army against the Persians; but committed the execution of his plans to Galerius, whom he had recalled from Illyricum for that purpose. The temerity of this prince subjected him to a severe defeat from the king of Persia; and, when he returned to report his ill success to Dioclesian, he experienced a cold and contemptuous reception, being allowed to follow the emperor's chariot several miles on foot, before he was indulged with an audience. But, when Dioclesian had thus displayed his superior authority, and Galerius had shewn his eagerness to retrieve his lost honour, he was again intrusted with an army of 25,000 men, with which he gained a decisive victory over the Persian monarch, and secured a peace of the most advantageous terms for the empire. His success completely re-established in that quarter the glory of the Roman name; but was attended with fatal consequences to Dioclesian himself. Galerius, elated with his conquests, assumed the pompous titles of Persicus, Armenicus, Medicus, Adiabenicus, and even styled himself the son of Mars. In this boastful disposition, he could not easily brook the thought of a superior; and, by his haughty demeanour, began to prepare Dioclesian for his future usurpations. That emperor, in the meantime, was busily occupied by the internal arrangements of the empire, and by the fortifications of its frontiers along the Euphrates, the Danube, and the Rhine. He spent the winter of the year 302 at Nicomedia, together with Galerius, whose ascendancy was daily increasing, and who was at this time keenly employing all his influence with his colleague, to procure the extermination of the Christians. Dioclesian himself, though much attached to the Heathen superstitions, did not entertain any aversion to the Christians; and had many of them among the officers both of his court and army. Galerius, on the contrary, had imbibed, from his infancy, the bitterest enmity against them, and was himself utterly ignorant of every subject, except military affairs. Influenced by the suggestions of his superstitious mother, the insinuations of the Pagan priests, and the ferocity of his own natural disposition, he solicited Dioclesian, with the most urgent importunity, to adopt the most violent proceedings against his Christian subjects. The emperor, much inclined to cement measures, consented to exclude all who professed that religion from every civil and military office, but was reluctant to shed blood. Galerius, however, at length prevailed; and, on the 23d of February 303, an order was issued to pull down the churches of the Christians, to confiscate their ecclesiastical property, to burn their sacred books and other writings, to render them incapable of holding any honour or employment in the state, and to exclude the whole mass from all the privileges of subjects, and protection of the law. Although this edict did not directly affect their lives, yet many of them, in consequence of refusing to surrender their sacred books to the magistrate, were punished with death. Soon after the publication of this edict, the palace of Nicomedia, in which both the emperors then lodged, was twice discovered to be in flames, and part of the building was reduced to ashes. This accident is ascribed by Constantius, who was upon the spot, to the effects of lightning; but Lactantius affirms, that it was done by the secret orders of Galerius, that he might find an accusation against the Christians.

To their account, whoever was the author, it was charged by that Prince; who, at the same time, took his departure from Nicomedia, declaring his dread of being burnt by their machinations. The timid and credulous Dioclesian, doubly exasperated by his terrors, let loose all the fury of his vengeance against his Christian subjects; commanded numbers of them to be put to death in the most inhuman manner, as incendiaries; and issued a second edict, ordering all their bishops and teachers to be cast into prison. A third edict speedily followed, directing every species of punishment and torture to be inflicted upon these unhappy captives, in order to compel them to join in the sacrifices of the Heathen deities, that by their example their respective congregations might be influenced to renounce their religion. In consequence of this barbarous mandate, multitudes of the most eminent and virtuous characters in every quarter of the empire, (excepting Britain and Gaul, where Constantius Chlorus befriended the Christians,) were put to death by inexpressible tortures, while others were sent to the mines to drag out the remainder of their days in the most humiliating servitude. In 304, a fourth edict was issued, at the instigation of Galerius, which required the magistrates to compel every Christian of every rank and sex, to offer sacrifice to the Heathen gods, and to employ every kind and degree of torture for this purpose. This persecution, which is generally reckoned the tenth, and which was much more bloody than any which had preceded it, continued to rage, with little abatement, for the space of ten years, when Galerius at length, suffering, in his turn, from the horrors of a mortal and excruciating disease, recalled these barbarous decrees, A. D. 311, and restored repose to the wretched remains of his Christian subjects. It had very nearly, indeed, proved fatal to the Christian name; and at one period of its progress, the tyrants themselves boasted, in a public proclamation, that they had extinguished that powerful superstition, and restored the worship of the gods to its former splendour.

From the commencement of this persecution, the Emperor Dioclesian, to whatever cause it may be ascribed, was pursued by a succession of calamities. After celebrating a magnificent triumph at Rome, A. D. 303, on account of the success of his arms, and his entrance into the twenty-third year of his reign, he retired to Nicomedia, with the design of prosecuting his embellishments of that favourite city. Here he was seized with a lingering disorder, which reduced him to a state of extreme debility, terminating in a species of epilepsy; and when he appeared again in public, about the beginning of the year 305, in order to dissipate the reports which were propagated of his death, he was so pale and emaciated, that he could scarcely be recognized by those who had been most familiarly acquainted with his person. Galerius, about the same time, returned to Nicomedia, requiring him to resign the imperial authority, as he was now become unfit to discharge its functions, and threatening to compel him by force, should he refuse to make a voluntary surrender of his power. It has been alleged, that such was in fact the private intention of Dioclesian, in consequence of his feeble state of health; but it is an unquestionable fact, that the execution at least of his purpose was hastened by the demands of his ambitious colleague, who had in like manner intimidated Maximian to retire at the same time from the sovereignty. On the same day, therefore, the first of May 305, Maximian at Milan, and Dioclesian at Nicomedia, publicly abdicated the imperial throne; and the latter immediately withdrew to a favourite residence in his native country of Dalmatia, near to the city of Salona. Here he built a magnificent palace, of which some remains are still to be seen, and which form a part of the modern town of Spalatro. In this retreat he amused himself with the operations of planting and gardening, in which he used to declare, that he enjoyed more happiness, than when he was adorned with the purple; and was often heard to exclaim, "Now it is that I live; now I see the beauty of the sun!" When Maximian afterwards solicited him to resume with him the reins of government, he is reported to have made the following reply: "I wish that you could come to Salona, that I might shew you the pot-herbs, which I have planted with my own hand, and I am sure that you would never again make mention to me of the empire." Though he was at first greatly honoured in his retirement, by his successors, yet he experienced many afflicting, or at least humiliating circumstances, both in his own condition, and in the treatment of his family. His wife Prisle, and his daughter Valeria, were both treated with the utmost severity by Maximian, and finally banished to the deserts of Syria, in spite of all his solicitations in their behalf; while he himself received some threatening messages from Constantine and Licinius, who had suspected him of being engaged in the disturbances occasioned by Maxentius. He was thus constantly in dread of suffering an ignominious death; and this apprehension, united with his distemper, threw him into such an agitation of mind and body, that he enjoyed no rest, either night or day, but spent his whole time in sighs and tears. At last, worn out by his suffering, or, according to others, having poisoned or starved himself, he expired in the 68th year of his age, A. D. 313. A magnificent tomb was erected to his memory, and he was deified with the usual solemnities.

It has been noticed as rather an unaccountable circumstance, that, though no reign was more remarkable for its length and its events, and though a great number of historians flourished during its course, yet there is none of the Roman emperors, whose history is more imperfectly known than that of Dioclesian. This has been ascribed by some writers to the hatred which the Christians bore to his memory, which led them to suppress all histories and memoirs of which he was the subject; and by others it has been considered as the just retribution of Heaven, for his endeavours to abolish the sacred records. It is generally admitted, that he was desirous of emulating good emperors, and diligent in promoting the welfare of the empire. He enacted many excellent laws, and studied particularly to render provisions abundant in his army, his capital, and in every quarter of the empire. He discountenanced vice, promoted virtuous characters to places of trust, and, until seduced by Galerius, was rather a friend than an enemy to the Christians. But he may be regarded as one who acted a part, and was naturally devoid of those qualities which constitute an amiable or estimable prince. Not to mention his barbarous persecution of the Christians, his general mode of government tended to the oppression of the people. He degraded the character of the senate, altered the very titles of the magistrates, and changed entirely the Roman system. His whole establishment was formed upon a principle of ostentation; and he imitated, in every thing, the stately magnificence of the eastern potentates. He assumed the diadem, which the Romans detested; and arrayed his person in the most sumptuous attire of silk and gold. He instituted a variety of forms at court, which precluded access to his throne, and entrusted the care of his palace to the vigilance of eunuchs; required every subject, even of the highest rank, when at length introduced into his presence, to fall prostrate to the ground, and to approach him as a divinity; ordained them even, it is said, to kiss his feet, and had his shoes, for the purpose of this ceremony, embroidered with gold, and studded with precious stones. He multiplied offices and magistrates not only in his own immediate service, but in every department of the state; a circumstance which produced an increase of the taxes, and tended to impoverish his subjects. He was wonderfully addicted to building, and embellished many of the principal cities with magnificent edifices. At Nicomedia, in particular, he indulged this passion to an extravagant and pernicious extent, erecting a mint, an arsenal, a circus, a palace for his wife, another for his daughter, and several royal residences for himself, obliging many of the citizens to abandon their habitations, in order to make room for these structures, and exhausting the finances of those that remained, by the expences of materials, workmen, and beasts of burden. Nor did he hesitate to pull down the most costly buildings, again and again, when they failed to please his fancy, and to cause them to be rebuilt upon a different plan. His baths, at Rome, were particularly remarkable for their magnificence and extent, being capable of accommodating 3,000 persons, and having more the appearance of a city than of a single edifice. His personal character was that of an experienced politician, without the presence of any shining abilities or estimable moral qualities. He was skilful in the direction of public business, and thoroughly versed in the knowledge of mankind; dexterous in conceiving his schemes, and steady in the pursuit of his ends, even while he prudently varied his means; capable of profound dissimulation, with all the appearance of military frankness; naturally inclined to violent measures, but at the same time master of his temper, and completely able to submit all his passions to the aims of his ambition, which he knew also how to invest with the semblance of justice and of public utility. He was well acquainted with the military art, but not very apt to expose his own person to danger; inclined to avarice, and bent upon amassing wealth, which he frequently procured by acts of cruelty. He was universally noted for pride and arrogance, generally suspicious and distrustful; while, at the same time, none of those whom he called his friends, could ever discover that sincerity of affection on his part, which would fully justify confidence on theirs. See *Ancient Univ. Hist.* vol. xv. p. 483; Gibbon's *Rom. Hist.* vol. ii.; Crevier's *Rom. Emp.* vol. ix. x.; Mosheim's *Eccles. Hist.* vol. i.; and Esprinchard's *Histoire Auguste*, p. 497. (*q*)

DIODIA, a genus of plants of the class Tetrandria, and order Monogynia. See BOTANY, p. 123.

DIOGENES, a celebrated Grecian philosopher of the sect called Cynics, was born at Sinope, a city of Pontus, in the third year of the 91st Olympiad, or 414 B. C. His father, Icetas, was a banker, who, being convicted of debasing the public coin, was banished from his native city. From thence he removed to Athens, where Diogenes offered himself as a pupil to Antisthenes, the founder of the Cynic sect, who at first peevishly refused to admit him. Diogenes still continuing to importune him, the surly philosopher lifted up his staff to drive him away, upon which the young student exclaimed, "Beat me as you please, I will still be your scholar!" Antisthenes at length consented to admit him; and he afterwards became his intimate friend and companion. From that period, Diogenes adopted the opinions and principles, and conformed to the austere habits of his master; distinguishing himself, upon all occasions, by a thorough contempt of riches and worldly honours, and an excessive indignation against every species of luxury. He wore a coarse cloak, carried a wallet and a staff, made the porticoes and other public places his habitation, and, like a common mendicant, sought a scanty and precarious subsistence in the casual contributions of charity. Having been disappointed in his endeavours to procure a cell, he is said to have taken up his abode in a cask, tub, or large open vessel, in the *Metroum*. This circumstance is alluded to by Juvenal, Sat. xiv. v. 308.

> " *Dolia nudi*
> *Non ardent Cynici; si fregeris, altera fiet*
> *Cras domus, aut eadem, plumbo commissa, manebit.*

> " The naked Cynic mocks such anxious cares,
> His earthen tub no conflagration fears;
> If crack'd or broken, he procures a new,
> Or, coarsely soldering, makes the old one do."
> GIFFORD.

This tub is also mentioned by other authors; but no notice is taken of it by several ancient writers, who have dwelt upon the particulars of the life of Diogenes; and it is therefore doubtful, whether this piece of his history be founded on fact, or whether it ought not rather to be reckoned among the number of those unaccredited stories, which were so frequently invented, related, and believed, in regard to the lives and habits of many of the ancient philosophers.

At an advanced period of life, Diogenes is said to have undertaken a voyage to Ægina; and having met with pirates, he was made prisoner, carried into Crete, and exposed as a slave to public sale. Being asked what he could do, he replied, "I can govern men; therefore sell me to one who wants a master." Xeniades, a wealthy Corinthian, being struck by the singularity of this reply, immediately purchased him; upon which Diogenes told him, that he should be more useful to him as his physician than as his slave. On their arrival at Corinth, Xeniades presented him with his liberty, and entrusted him with the direction of his children's education, and with the management of his domestic concerns; in which situation Diogenes acquitted himself so much to the satisfaction of his master, that the latter used to say, the gods had sent a good genius to his house.

During his residence at Corinth, Diogenes frequently attended the assemblies of the people at the *Craneum*, in the vicinity of the town, and at the Isthmian games; omitting no opportunity of inveighing against the vices and follies of the times, and inculcating the practice of temperance and virtue. It was upon one of these occasions, that the conference between Alexander the Great and Diogenes is said to have taken place. The story is of doubtful authenticity, but it is thus related by Plutarch. After the death of his father, Alexander received the congratulations of all ranks on his being appointed to the command of the Grecian army, in their projected expedition against the Persians. Upon this occasion, Diogenes was absent; and Alexander expressed his surprise at the circumstance. Anxious, however, to gratify his curiosity by the sight of such a celebrated philosopher, he visited the Craneum, where he found Diogenes sitting in his tub in the sunshine. The king approached him amidst the crowd, and said, "I am Alexander the Great;" to which Diogenes replied in a surly tone, "and I am Diogenes the Cynic." After conversing with him for some time, Alexander asked if there was any service he could render him? "Yes," said Diogenes, "not to stand between me and the sun." Surprised at the magnanimity of this reply, the king exclaimed, "If I were not Alexander, I would be Diogenes!" These circumstances are alluded to by Juvenal, in the sequel of the passage already quoted:

> "Even Philip's son, when in the little cell
> Content he saw the mighty master dwell,
> Own'd, with a sigh, that he who nought desired,
> Was happier far than he who worlds required," &c.
>
> GIFFORD.

And the author of Hudibras, with his usual humour, contrasts the unbounded ambition of the Macedonian conqueror, with the philosophical contentment of the Cynic:

> "The whole world was not half so wide
> To Alexander, when he cry'd,
> Because he had but one to subdue;
> As was a paltry, narrow tub to
> Diogenes, who ne'er was said,
> For aught that I could ever read,
> To whine, put finger i'th'eye, and sob,
> Because he'd ne'er another tub."

It has not been satisfactorily ascertained at what period, and in what manner, the death of Diogenes took place. It is most probable, however, that he died at Corinth, of mere decay, in the 90th year of his age, in the 1st year of the 114th Olympiad, or 324 B. C. He was buried by the Athenians in an honourable manner, at the public expence; a column of Parian marble, terminated by the figure of a dog, was placed over his tomb; and his friends and disciples erected many brazen statues to his memory.

At this distant period, it is almost impossible, without the assistance of any authentic written memorial, to ascertain, with any near approximation to truth, what were precisely the substance snd tendency of the doctrines promulgated by Diogenes. The accounts which have been transmitted to us by ancient authors, are confused and contradictory. But there seems little reason to doubt, that he practised the most hardy self-controul, and the most rigid abstinence; that he was earnestly desirous of correcting and improving the public morals; and that he censured, with steadiness and severity, the reigning vices and follies of the age. At the same time, he appears to have carried both the cynical habits and philosophical doctrines of his master Antisthenes, to an extravagant extreme. True wisdom does not require a sacrifice of the common comforts of life; and in the affected humility of Diogenes, there evidently lurked a degree of philosophical pride, not inferior to that of many of the individuals who incurred his censure. "I trample under foot the pride of Plato," said Diogenes, treading upon his robe. "Yes," replied Plato, "with greater pride of your own." From his favourite dogma, "that every act which inferred no moral guilt, might be practised openly under the eye of the public," he is said to have deduced consequences in the highest degree disgusting. But it is difficult to believe, that an individual who has been extolled by some of the most ancient philosophers for his sobriety and virtue, and represented as one endowed with divine wisdom, should have been capable of inculcating such revolting doctrines, or of committing such gross indecencies as have been laid to his charge.

See Bayle, Brucker, Enfield, and Meiners, *Geschichte der Wissenschaften in Griechenland und Rom.* (z)

DIONÆA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 212.

DIONYSIA. See GREECE and MYTHOLOGY.

DIONYSIUS. See SYRACUSE.

DIOPHANTINE PROBLEMS. See ALGEBRA and MATHEMATICS.

DIOPTRICS. See OPTICS.

DIOSCOREA, a genus of plants of the class Diœcia, and order Hexandria. See Brown's *Prodromus Plant. Nov. Holl.* &c. p. 294, and BOTANY, p. 336.

DIOSCORIDES. See BOTANY, p. 2.

DIOSMA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 153.

DIOSPYROS, a genus of plants of the class Polygamia, and order Diœcia. See BOTANY, p. 346.

DIOTIS, a genus of plants of the class Monœcia, and order Tetrandria. See BOTANY, p. 322.

DIPHTHONG. See GRAMMAR.

DIPHYLLEIA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 197.

DIPHYSA, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 284.

DIPLANTHERA, a genus of plants of the class Tetrandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl.* &c. p. 449, and BOTANY, p. 131.

DIPLARRHENA, a genus of plants of the class Triandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl.* &c. p. 304, and BOTANY, p. 113.

DIPLASIA, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 115.

DIPLAZIUM. See FILICES.

DIPLOLEPIS, a genus of plants of the class Pentandria, and order Digynia. See Brown, *Wernerian Transactions*, p. 30; and BOTANY, p. 181.

DIPLOPOGON, a genus of plants of the class Triandria, and order Monogynia. See Brown's *Prodromus Plant. Nov. Holl.* p. 176. and BOTANY, p. 114.

DIPODIUM, a genus of plants of the class Gynandria, and order Monandria. See Brown's *Prodromus Plant. Nov. Holl. et Ins. Van. Diem.* p. 330; and BOTANY, p. 318.

DIPPEL, ANIMAL OIL OF. See CHEMISTRY, p. 135.

DIPPING. See DYEING.

DIPPING NEEDLE. See MAGNETISM.

DIPSACEÆ. See BOTANY, p. 79.

DIPSACUS, a genus of plants of the class Tetrandria, and order Monogynia. See BOTANY, p. 119.

DIPTERYX, a genus of plants of the class Diadelphia, and order Decandria. See BOTANY, p. 274.

DIPUS. See MAMMALIA.

DIRCA, a genus of plants of the class Octandria, and order Monogynia. See BOTANY, p. 203.

DISA, a genus of plants of the class Gynandria, and order Diandria. See BOTANY, p. 313.

DISANDRIA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 197.

DISAPPOINTMENT, ISLANDS OF, is the name given to a cluster of islands in the South Pacific Ocean, by Commodore Byron, by whom they were discovered in 1765, on account of his being unable to procure any refreshments for his sick crew. The smallest of the two principal islands is about five miles in circumference, and had a most beautiful appearance. It was encircled with a beach of the finest white sand, and was covered with tall trees, which formed the most delightful groves, and extended their shade to a great distance. The natives were of a deep copper colour, and exceedingly stout and well made. They were remarkable for their agility, and astonished Commodore Byron with the extreme rapidity with which they run. They carried large spears about 16 feet long, and would not permit the crew to land on their island. The larger island was also inhabited. The middle of this cluster of islands is in West Long. 145° 4′, and South Lat. 14° 5′. (*j*)

DISAPPOINTMENT ISLAND, is the name of an island in the South Sea, which was discovered by Captain Wilson in 1797. It is one of the cluster called Duff's Groupe, which are about eleven in number, having two large islands in the middle, about six miles in circumference. Several other islands are situated on the north-west side of the groupe, and there is a remarkable rock in the shape of an obelisk at the east end of one of them. The two large islands were covered with wood. The houses were built close to each other; and the natives were stout and well made. The small islands were apparently barren. East Long. 167°, South Lat. 9° 57′. See *Missionary Voyage*, p. 296. (*j*)

DISCHARGE OF FLUIDS. See HYDRODYNAMICS.

DISCHARGER. See ELECTRICITY.

DISCHIDIA, a genus of plants of the class Pentandria, and order Digynia. See Brown's *Prodromus Plant. Nov. Holl.* &c. p. 461, and BOTANY, p. 181.

DISCORD, in Music, called *Diaphorica* by the ancients, is the peculiar and disagreeable effect on the organs of hearing, excited by two or more sounds, when heard together and united, which are not in certain relation to each other, and are called CONCORDS. See that article. The physical distinction, or cause of the difference between discord and concord, is yet involved in considerable difficulties. We know, however, from experiments, so often repeated and varied as to leave no doubts, that except the eight intervals in the octave (including its extremes, as was done in deriving its name,) which are indeed *concords*, viz. I, 3d, III, 4th, V, 6th, VI, and VIII, and others formed by the addition of an eighth, or of two, three, &c. eighths, (VIII) to each one of these respectively; and excepting also a certain extent of intervals within fixed limits of each one of these concords on each side, which are called *Imperfect Concords*, (and are distinguished by audible BEATS, see that article.) All other intervals whatever, great and small, are *discords*, although having different degrees of unpleasant effect on the ear, as Mr Liston's euharmonic organ is best calculated, of any other method, for exemplifying by experiment.

It has been ascertained, that Beats, or any other noise repeated at uniform periods of time, quicker than 12 or 13 times in one second of time, cease to be heard separately, and unite into a new continuous sound. In the following Table we have calculated the sharp temperaments necessary to be applied to each of the concords in the octave above the tenor cliff C, in order to produce 12 beats in a second in each case respectively, viz.

VIII	C	$\frac{1}{2}$	480	21.8806
VI	A	$\frac{3}{5}$	400	8.8172
6	A♭	$\frac{5}{8}$	384	5.5210
V	G	$\frac{2}{3}$	360	14.6470
4	F	$\frac{3}{4}$	320	11.0079
III	E	$\frac{4}{5}$	300	8.8172
3	E♭	$\frac{5}{6}$	288	7.3537
I	C	$\frac{1}{1}$	240	43.2340

In the 1st column the intervals are expressed, in the 2d the notes, in the 3d the ratios, in the 4th the complete vibrations in 1″ made by each note, and in the 5th the sharp temperaments, which will produce 12 beats in 1″, expressed in schismas, whereof 614.212639 make the octave.

The grave temperaments of each of these concords will be a little less, respectively; but if we suppose them equal, and we double all the temperaments but those of I and VIII, and add these to the product, we have about 177 Σ for the extent within which imperfect or beating concords can be produced in this octave; and the remainder, or 437 Σ nearly, will produce discords only. Whence it appears, that if any two sounds are produced at random, within the limits of his octave above the tenor cliff, the chances are nearly as $3\frac{1}{2}$ to 1 that they will produce a discord, instead of a tempered or beating concord, or a perfect concord, for which last effect the chances are very few.

By the above Table it will be seen, how very unequal the limits are, within which the concords produce *beats* respectively. In the next superior octave, the halves of these numbers, and in the next above the halves of these again; in the next octave below tenor-cliff C, the double of these numbers, and 4 times in the next descending octave, will produce approximate sharp temperaments of the concords respectively, for producing 12 beats per second, such as Dr Smith deduces from the *ultimate ratios*, ("Harmonics," prop. xi. cor. 3.) but which are not exact, as will be seen by multiplying each of our numbers in col. 5. by the denominator of its fraction in col. 3, which will not invariably produce a product of 43.2340, as would be the case, if the ultimate ratios were the very same as the true ratios, that are used in the 2d and 4th method of calculating, in our article BEATS. (*g*)

DISCOUNT, in trade, is expressive of an abatement allowed in consequence of anticipating a fixed period for payment. When a bill has two months to run, and a banker gives money for it on receiving the two months interest, the interest so received is called discount. When a warehouseman sells goods at ten months credit, but on receiving ready money, consents to abate $7\frac{1}{2}$ per cent. the sum abated is called the discount. The extent of discount granted in this manner by persons in trade, is larger than might be inferred from the magnitude of the commercial capital in this country. Ten per cent. for twelve, or at least for fourteen months, is quite common in London. The greatness of this discount is owing to the risk that would be incurred by the seller in giving credit, as well as by his extending his trade beyond his capital. In this, as in other respects, the political economist has ample reason to lament the effects of expensive war. The vast sums levied by government in loans and taxes operate to keep the money market bare, and to prevent the application of the funds of capitalists to commercial purposes. At different periods in the course of last century, the interest of money was 4 per cent. but during the last 20 years, it has been 5 per cent. and by no means easily procured at that rate. Were we to investigate the disclosures made in courts of justice in regard to annuity transactions, we should be surprised to find that 10 per cent. had, not unfrequently, been paid on security, which, to most persons, would appear to entitle the holders to pecuniary accommodation at a much lower rate. In Holland, in the days of her commercial prosperity, the rate of interest was remarkably low. Three per cent. and frequently two and a half, might be put down as the current premium on good security for the century preceding the unfortunate war of the present age. In France, on the other hand, interest has been all along much higher than with us. Though the rate of discount on bills does not exceed 6 per cent. we believe that for a permanent loan, it is not uncommon, in that country, to obtain 8, 10, or 12 per cent. with security which is generally accounted unexceptionable.

In several branches of trade in this country, it is common for the seller to tempt the buyer with the offer of a large discount; 15, 20, and even 25 per cent. being frequently allowed in this manner. Such a practice ought not to be encouraged, the allowance being a mere delusion. It needs no proof to shew, that whatever is deducted in this way must be previously added to the charge of the goods, and that the same result would be attained by stating, in a single line, the lowest ready money price. This custom has farther the bad practical effect of awakening the suspicion of foreign merchants, who, hearing that in certain lines large discounts are allowed, may be inclined to consider the practice in the light of a collusion between their correspondent and the manufacturer of whom he makes his purchases. As trade improves in the mode of its management, the habit of discount, at least of large discounts, may be expected to give way. The buyer coming with money in his hand, will go the shortest way to work, and the seller will find it his best policy to say at once the least price which he can afford to take.

Bankers and other persons discounting bills, take payment of the interest at once, without waiting for the lapse of the specified term of days or months. Whether this be strictly in the spirit of the law, we do not pretend to determine. Its practical result is to afford the banker, in the case of discounts frequently repeated, an interest of $5\frac{1}{4}$ or $5\frac{1}{2}$ per cent. for his money during the year. This, however, is no grievance, as the applicants are aware of it, and as, in the season of war, it is generally a favour to discount bills on those terms. In peace, there is seldom room for complaint, as interest frequently falls below the legal limit, 4 per cent. being the ordinary allowance in times when government has not occasion to make heavy demands on the money market. (χ)

DISDIAPASON, in Music, (XV) or Bis-diapason, is a concordant interval or concord, whose ratio is $\frac{1}{4}$, $=1224\Sigma+24f+106m$, the double octave, 2VIII, or Fifteenth *Major*, which see.

DISDIAPASON, *Diapente* (XIX), this concord is $2VIII+V$, and has a ratio $\frac{1}{6}$, $=1582\Sigma+31f+137m$. See Nineteenth *Major*.

DISDIAPASON, *Diatessaron* (18th), is $2VIII+4th$, and this concord has a ratio $\frac{3}{16}$, $=1478\Sigma+29f+128m$. See Eighteenth *Minor*.

DISDIAPASON, *Ditone* (XVII), this concord is $2VIII+III$, and has a ratio $\frac{1}{5}$, $=1421\Sigma+28f+123m$, See Seventeenth *Major*.

DISDIAPASON, *Semiditone* (17th), is $2VIII+3d$, and this concord has a ratio $\frac{5}{24}$, $=1385\Sigma+27f+120m$. See Seventeenth *Minor*.

DISKO Bay. See Greenland.

DISMAL Swamp, Great, is the name of an immense bay on the confines of Virginia and Carolina, extending about 30 miles from North to South, and having a medium breadth of about 10 miles. Reeds, about 12 feet high, interspersed with Bamboo briars, cover the north east margin of the swamp, while the southern margin exhibits a large track of green waving reeds, which has received the name of the Green Sea. An evergreen shrub, called the gall bush, with a berry that gives a black dye, is found here in abundance. Near the middle of the swamp, both cypress and cedar trees grow in abundance; but they are easily blown down by a moderate wind. No living animal is found in the neighbourhood, the noxious vapours being prejudicial to animal life, and engendering agues and other disorders. Five navigable rivers have their origin in this swamp, namely the south branch of Elizabeth river, and the south branch of Nansemond river, both of which flow into Virginia, and the North River, North West River, and Perquimons, which run into North Carolina. The sources of these rivers are concealed in the swamp, and must therefore be supplied from some subterraneous springs, or by the water that runs into the swamp from the high lands. The last of these suppositions is the most probable, as the swamp is a mere quagmire, which shakes under the feet of those who walk upon it, every mark of the foot being instantly filled with water. On the western margin of the Dismal is a pine swamp above a mile broad, the greatest part of it being covered with water about two feet deep. The bottom being firm, the pines grow to a very great height, and are not easily overthrown by the wind. Notwithstanding these disadvantages, some parts of the Dismal exhibit scenery by no means unpleasing. Fragments of trees are found buried and preserved under the vegetable earth, at different degrees of depth, as in the plains which rise in the form of a terrace near the bed of the river Connecticut. When dug out of the ground, they are soft, but they grow hard by exposure to the air. The Duke de Rochefoucault remarks, that the Dismal Swamp has less solidity than any which he has seen; but that the earth which is dug out of it hardens in the air, and forms an excellent dike.

In the middle of Dismal Swamp is a lake about seven miles long, called Drummond's Pond, which discharges its waters to the south, into Pasquotank river, which runs into Albemarle Sound, and on the north into Elizabeth and Nansemond river, which flow into James' river.

In 1777, a canal was forming through Dismal Swamp. It was to pass about a mile East of Drummond's Pond, and was to unite the south branch of Elizabeth river, or rather of Deep-Creek, which falls into it, with Albemarle Sound, by means of the river Pasquotank. The canal company was incorporated by the legislature of North Carolina and Virginia. The length of line is 28 miles, and the soil through which it lay was very easily wrought. In 1796, five miles had been dug on the Virginia side, and as many on the side of North Carolina, so that only 18 remained to be cut, which they expected to accomplish in three years.

The principal object of this canal is to shorten and facilitate the communication between North Carolina and Norfolk. It will thus open an inland navigation from the head of Chesapeak Bay, including all the rivers in Virginia, to George town in South Carolina; and when the canal from Elk River to Christiana Creek is opened, the communication will extend to Philadelphia, and to the ports connected with Delaware river. The Swamp principally belongs to two companies; the Virginia Company, which possesses 100,000 acres; and the North Carolina Company, which possesses 40,000. See Morse's *American Gazetteer*, and Rochefoucault de Liancourt's *Travels through the United States of North America, in* 1795, 1796, and 1797, vol. ii. (*w*)

DISNIA. See Dissima.

DISPASIS, a genus of plants of the class Gynandria, and order Diandria. See Botany, p. 313.

DISPERSION of Light. See Achromatic Te-

LESCOPE; but particularly OPTICS, where our readers will find the most copious table of *Dispersive powers* that has yet been published.

DISS, a market town of England, in the hundred of Diss, of the parish of Norfolk. It is said to derive its name from a large muddy pool of water, lying on the south side of the town, and abounding with eels. Diss is situated on the northern bank of the river Waveney, which here separates the counties of Norfolk and Suffolk. It consists of several streets, the principal of which are paved, and the houses have a comfortable and respectable appearance. The church consists of a chancel, nave, and two aisles, with a square tower at the west end, and is remarkable for the cleristory tier of windows. They are arranged in pairs, five of which are on each side of the nave, and there is a plain pilaster between each pair. The arch which forms the head of the windows is a waving line. There is a semicircular arch above the door of the south porch, and over it is a window formed of seven arched lights. The other establishments are a neat Presbyterian and Quaker meeting, and a charity school, kept in a building which was formerly the guild-hall.

In the year 1773, when a vault was sinking in the church, the workmen discovered a stone coffin containing a skeleton in high preservation, with a pewter chalice near the head; two large empty earthen urns were found near the coffin. The principal manufactures of this town are hempen cloths, hose, and stays.

The following is an abstract of the population return for the parish of Diss in 1811.

Number of inhabited houses,	348
Families that occupy them,	520
Ditto employed in agriculture,	69
Ditto in trades and manufacture,	78
Males,	1181
Females,	1409
Total population in 1811,	2590

See Blomefield's *History of Norfolk*; and Evans' and Britton's *Beauties of England and Wales*, vol. xi. p. 228, 229. (*w*)

DISSIMA, DISNIA, DISMA, or more properly DEZIMA, is the name of an island or peninsula of Japan, situated near the town of Nangasacki. This island is about 600 feet long, and 120 broad, and is separated from the town and mainland, at low water, by a ditch, over which there is a bridge to form the communication at high water. This island is planked in on all sides, and has two gates, one towards the town near the bridge, and the other towards the water side. The first is always guarded in the day-time, and locked at night, and the latter is only open when the Dutch ships are loading or unloading.

This island is let to the Dutch Company by the inhabitants, who build and keep in repair all the dwelling houses. The emperor's edicts for the regulation of the Dutch trade, are hung up on several tables, upon a large stone pillar, at the entrance of the bridge; and such is the jealousy of the Japanese government, that they have three watch houses in the island, and a guard-house where every person is searched. The Dutch are not even permitted to converse with the guards or with the natives, excepting those who are appointed factors and brokers by the governor of Nangasaki. They were not even allowed to have lighted candles in their houses, or on ship-board, and if any noise or disturbance was heard, the ottonas or reporting officers immediately gave notice of it by blowing a horn, and a party was instantly dispatched by the governor, to inquire into the cause of it.

The houses and store-houses of the Dutch Company are built lengthwise upon the island, in the form of a small town. They have also an hospital, and separate houses for their servants, who inhabit the upper story, while the lower one is filled with stores and lumber. Two streets crossed by a third, run between these store-houses. The store-houses are all fire-proof, but the dwelling houses are made of wood and clay, and covered with tiles, and have paper windows, and straw mats for the floor. The interpreters have a large house on the island, called their college, and there is another house for the ottonas. According to the observations of Krusenstern, the flag-staff of Dezima is in north latitude 32° 44′ 18″. The east longitude of the centre of the town of Nangasacki, according to the same observations, is 30° 7′ 53″. See Krusenstern's *Voyage round the World*, vol. i.; and Milburn's *Oriental Commerce*. (*π*)

DISSIPATION OF LIGHT. See OPTICS.

DISTANCES OF THE PLANETS. See ASTRONOMY.

DISTANCES, METHODS OF MEASURING. See TRIGONOMETRY.

DISTILLATION,

A PROCESS in chemistry, by which one body is separated from another, by taking advantage of the relative temperatures at which they assume the elastic form, and afterwards condensing the vapour in a separate vessel.

When the vapour condenses into the solid form, such as sulphur, corrosive sublimate, calomel, &c. the process is termed sublimation. In this case, the substance to be distilled may be placed in the bottom of the vessel where the heat is applied. The vapour rising to the upper part, adheres to it. It is more common to have an upper vessel inverted directly over the lower one, for the reception of the vapour, which, when it is condensed upon its interior surface, can be removed in the form of a cake. The sub-ammoniac of commerce is sublimated in this form, and also corrosive sublimate and arsenic.

When the condensed vapour is obtained in the liquid form, the shape and situation of the vessels are very different. The vapour should be kept completely in its elastic form, to a certain height. The neck of the vessel should then turn by a sharp curve, on an elbow, so that the substance, after condensation into the liquid form, may, by its gravity, descend as quick as possible. The height of the elbow above the point where the heat is applied, should be only sufficient to guard against the mass below getting over the neck, by boiling or any other cause of agitation. When the neck of the lower vessel is liable to be long, it should be defended in some way, either by being polished or clothed, to prevent the escape of heat, in order to allow the vapour to be carried over into the descending part, before it condenses. The vessel from which the vapour rises, when of large size, and used for distilling simple liquids, is called a *still*. Those used for experiments in a small way, and also for distilling acids, ammonia, ether, &c. are called *retorts*; the vessel that receives the distilled matter being called a *receiver*. See *Chemical Apparatus*, under CHEMISTRY.

The retort is the most simple of the distilling apparatus, but it can only be employed when the vapour is easily condensible, or when little heat is applied. When expedition is an object, recourse is had to a more compound apparatus, by which the condensation is facilitated. It is to this that the name *still* is more properly applied.

The most simple of this variety is the alembic. It consists of a lower vessel, terminating in a narrow neck, which, with the substance that is to be distilled, is applied to the fire. At a certain height, depending on the nature of the substance, is placed upon the neck, a spacious vessel, which is exposed to the air, or kept cold by a supply of cold water, in order to condense the vapour as quick as possible. If exposed to the air, it should be painted of japanned black. Round the bottom of the interior is a projecting channel to receive the liquid arising from the condensation of the vapour, which runs down the sides of the open vessel, in preference to falling back into the still. From this channel, the liquid descends by a pipe, placed at a certain angle into a receiver. This apparatus is sometimes made of glass, for small experiments, but more frequently of metal. It is at present not often used, the condensation by the worm tub being much more effective.

When the worm tub is employed, the still requires to have such a shape, that the greatest possible surface may be exposed to the fire. For this purpose, it is made in the form of a frustum of a cone, the base being as large as convenient, and the altitude very little. The neck should be of such width, as to convey the vapour as fast as formed. The height of the neck is regulated by the nature of the substance. If it is mucilaginous, such as the wash from which spirit is distilled, the neck should be longer, to prevent its boiling over. The exterior surface of the descending part of the neck, in this case, should be polished, to prevent the escape of heat. The descending part, at the same time, should be painted black. The end of the latter is inserted into the neck of the worm.

The worm tub consists of a wooden vessel, about six or eight times the capacity of the still. The length to the diameter is about 10 to 7. The worm consists of a spiral tube, which enters on one side of the tub, at the top: it then passes spirally, in about six or eight convolutions, to the bottom, where it comes out of the side, in order to discharge the liquid arising from the vapour condensed within it, by the agency of the cold water, with which the tub is filled. The water is constantly changing, by the warm water running away from the top, whilst a supply of fresh cold water comes in at the bottom. The section of the tube being a circle, its capacity should not be less than one-fifth of that of the still: the diameter of the ends of the tube being about three to one. The object is not merely to effect a condensation, but to cool the liquid, so that it may be less liable to evaporation after coming over. The proportions of the means of condensation to that of evaporation, will not always depend upon the relative sizes of the vessels, but will be governed by the quantity of vapour supplied in a given time, and the supply of cold water. In order to enter into the subject theoretically, by which we shall be enabled to give a more enlightened view of this branch of art, we shall divide it into two heads, namely, *Evaporation* and *Condensation*. The first will comprise the quantity of heat taken by different liquids to become vapour, and the means of furnishing the heat at the expence of fuel, with the best means of applying and regulating the latter. The second head will embrace the transference of the caloric from the vapour to some other medium, such as cold water, and the means of furnishing an adequate supply. To the above it may be necessary to add the different means of rendering substances less volatile which are not intended to rise, and of giving greater volatility to those which are wished to be procured.

In the application of fire to a vessel containing a substance to be evaporated, the fire should be so placed upon a grate, that a due supply of air may be admitted to produce a vigorous combustion. No air should be supplied but through the grate; and the quantity of heat will be the greatest, when no more air enters than is sufficient for the combustion, an excess serving only to cool what the fire has heated. The escape of the smoke and hot vapour should be at a point not higher than the level of the grate. This is to prevent the heated matter from escaping before it has parted with its heat to the vessel, by which its specific gravity is increased, and it descends in consequence. When the bottom of the vessel to be heated is circular, which is the case with the common spirit still, the exterior surface being also concave, the fire should be placed in the middle of the circle. The flame and heated vapour first rises up against the middle of the concave bottom; it then should take a direction towards the periphery of the circle; but, at the same time, it should have descended as low as the level of the grate. It should now enter the flue through a narrrow neck, which extends through the whole periphery of the circle, and which opens into the flue all round. This narrow aperture, which would be liable to be filled with soot and the light ashes, should be provided with a rake, which should work in the circumference of the circle: This being pushed, by a handle, to the right and left, on the outside, from time to time, keeps the circular neck clear. This long narrow aperture prevents the rapid escape of the heated vapour, before the heat is expended upon the vessel, and will be found much superior to the plan of labyrinthal flues in economising fuel. From what has been observed, it will be almost needless to suggest, that the greater the diameter of the vessel to be heated, the more completely will the vapour give out its heat, having, in this case, to make a longer rout to get to the flue. Hence it will appear, from this and other reasons, that the form of a still should be such, that its diameter will admit of the greatest possible quantity of heat being given out upon its bottom. Its depth, at the same time, should be the least possible, in order that the surface of the fluid may be as near as possible to the source of heat. The economy of the fuel will be still more increased, by having a double door to the fire-place. The size of the fire-place should vary with the quantity of liquid required to be distilled in a given time. In the Scotch distilleries, where the duty is paid for the time the still is employed, it is the interest of the distiller to apply the heat in such a way, as to get the greatest produce in a given time. It should be recollected, however, that this expedition is attended with bad consequences, so far as regards the purity of the spirit. When the ebullition is violent, which must be the case in the expeditious way, there is greater risk of the matter getting over in the liquid state to a certain degree, by which the distilled product would be liable to be contaminated. We are informed, that in some of the Scotch stills, as much as 160 gallons is drawn from a 500 gallons still in 20 minutes. Supposing one-third of this product to be spirit and the rest water, the spirit would require an expenditure of 26 lb. of the best Newcastle coal, and the water 107 lb.; making 133 lb. or nearly $1\frac{1}{3}$ bushels of coal. This is more by half a bushel than is consumed by a steam engine of 40 horse power. The means of condensation in a process so rapid must have been also very great. The vapour of the 53 gallons of spirit, during its condensation, would raise the temperature of 340 gallons of water at 50° to 120°, while the vapour of the 107 gallons of water would raise 1440 gallons of cold water through the same range of temperature. The total supply of cold water in 20 minutes would, therefore, be 1547 gallons, or 77.3 gallons in one minute.

When the distillation is very rapid, as in the instance above alluded to, the wash, or fermented wort, from which the spirit is drawn, abounds with so large a quantity of mucilage, and other vegetable matter, that it is very liable to deposition. This matter is apt to burn on the bottom of the still, producing an empyreuma, which gives a disagreeable flavour to the spirit. This evil, however, is in a great degree obviated by a piece of machinery, which works in the still by a motion communicated from the outside. It consists of a rake, which is constantly turning in contact with the bottom of the still. In the first distillation from the wash, in which about one-third of the whole is drawn off, this apparatus is absolutely necessary. This product is called *singleings*. This last undergoes a second distillation, from which about one-third of the whole is drawn. In this stage, it will be evident, that the machinery for raking the bottom will be unnecessary.

In the second distillation it will be proper to remark, that, in consequence of the distilled product being almost wholly spirit, the means both of evaporation and condensation will require to be less. The quantity of caloric required to raise water into vapour, is about 1 lb. of coal for every gallon of water. The latter will then require about 13 gallons of water at 50° to condense it, and reduce it to the temperature of 120°. The same quantity of heat will raise a little more than double the quantity of pure spirit into vapour. The same fuel and cold water, therefore, which would be expended on one gallon of water in its distillation, would distil more than two gallons of spirit. Count Rumford has lately ascertained, that the quantities of heat required to raise water and alcohol into vapour, are something more than 2 to 1; and he is of opinion, that ether requires about one-half the quantity of heat with that of alcohol. Hence we should conclude, that the means of evaporation and condensation for water will be four times that required for *ether*.

Besides the alcohol, which comes over with greater facility than the water, there are other volatile matters which are furnished by the vegetable substance from which the fermented liquor is procured. These are essential oils, which are different in the different fermented liquors. When they are from wine, or from the wash made from sugar, their aroma is rather of an agreeable flavour, and the rectifier becomes less anxious about their separation. Those essential oils which are afforded by the wash made from malt, or other grain, are very disagreeable to the smell; and, in this case, the purification of the spirit has long been a desirable object to the rectifier.

The rectifier buys his spirit from the distiller, in the state of what is called raw spirit. This generally abounds with all the impurities which are volatile, little or no pains being taken to purify the spirit in the first process. Every rectifier has his secret for purifying his spirit. It very often happens, however, that, instead of removing the offensive aroma, he substitutes one which overpowers and disguises the original. This is mostly the case in the different kinds of gin, and other compound cordials. In some instances, when the spirit is very weak, and the essential oils are abundant, the water exerts a greater attraction for the alcohol than that of the alcohol for the oil; by which means the oil becomes free in the liquid, giving it a turbid and milky appearance. In this case, the separation of the oil becomes an object. It is common to add alkalies for the purpose, forming saponaceous compounds with the oil, by which it acquires a greater degree of purity, and is less liable to rise in the rectification, which consists in distilling with a moderate heat. Acids have the property of converting essential oils into resinous substances, by which they become less volatile, and are, in consequence, easier to separate from the alcohol by distillation with a low heat. The rectifier employs a distilling apparatus similar to the distiller in every respect, but he proceeds with more care in the application of his heat.

Distillation of water.

In the distillation of water, so constantly required in medicine and in the laboratory of the chemist, much more precaution is found necessary than was formerly thought to be the case. The impropriety of distilling river waters, or others liable to contain animal and vegetable matter, it will be needless to point out, as it is well known that such distilled water is liable to putrefaction. The water to be distilled should be the most complete spring water, taken from some place where it has not run over any vegetable soil. If it contain muriate of lime, or any other very deliquescent salt, these salts are found to rise with the water, and never fail to exist in the distilled water. When the water to be distilled contains muriate of lime, the addition of a little soda decomposes the salt, producing muriate of soda and lime, neither of which will rise in distillation. It is owing to the presence of the muriate of lime in sea water, that has rendered it so difficult to purify it by distillation.

The distillation of what is called crude ammonia, or hartshorn, is carried on upon a large scale in several parts of the kingdom. The materials to be distilled are in general bones and hoofs of animals. On some occasions urine is used for the same purpose.

Distillation of bones.

In the distillation of bones, an iron still is generally used, with a pipe leading from it, connected with a worm tub, similar to that already described. The vessel being filled with bones roughly broken, a strong heat is applied. Water and animal tar first come over, accompanied by a very fetid inflammable gas: Carbonic acid gas also comes over, but the latter is mostly taken up by the ammonia, which is also formed at the same time. These come over into the receiver in the state of carbonate of ammonia. When the different substances have been condensed in the worm, they should pass into a receiver, which has no communication with the open air. This would not only render it almost impossible to exist in the same place, but would constitute a nuisance in the vicinity of any town.

The receiver should have no opening outwards, but through a pipe inserted into the upper part of it, and connected with the fire of the still. The inflammable gas and the smell are conveyed to the fire, where the former takes fire and burns. It may be proper here to hint one precaution, to avoid an accident: When the evolution of the inflammable gas becomes slow, or ceases entirely, the common air comes with the flame along the pipe into the close receiver, which is filled with the same inflammable gas. Under these circumstances an explosion will take place, which will not only burst the receiver, but do other injury. This evil will be avoided, by placing a valve in the pipe opening outwards, and another upon the receiver opening inwards: By this means the flaming gas will be stopped in its passage to the receiver, while the valve into the receiver will open to admit the common air, to fill up the vacuum. By means of the above apparatus, if it be well constructed, and proper luting employed, the distillation of hartshorn may be carried on almost without smell.

The first product consists of water, animal tar, and carbonate of ammonia. A great part of the tar may be separated mechanically; the rest is subjected to a second distillation with a gentle heat. The liquid which comes over consists of a solution of carbonate of ammonia, with a fetid animal oil, which gives it a peculiar odour. This liquid has been sold in the shops under the name of spirit of hartshorn. The animal matter contained in this substance, was at one time thought to possess certain medical virtues. This idea becoming obsolete, has led to the substitution of what is termed the aqua-ammonia. This is formed by distilling the muriate or sulphate of ammonia and quicklime. The lime takes the acid from the salt, setting the ammonia free, which comes over in the state of gas, and is absorbed by water. This liquid is called aqua-ammonia.

In the manufacture of printed calico, a large quantity of acetic acid is employed, for the preparation of certain mordants. The acetic acid used for this purpose, is procured from wood by distillation.

Distillation of wood.

The still is made of cast or wrought iron, and very strong, so as to bear a red heat. The wood is piled up in the still in the state it is used to make charcoal. The heat required is similar to that required for distilling bones. Water and vegetable tar, with acetic acid, come over, accompanied by the carbureted hydrogen gas. The former of these products are condensed in the worm, and run into a receiver. The gas escapes at an aperture for the purpose, and is sometimes burnt, to illuminate the place. It would be advisable to let the gas pass under a gasometer, in order to preserve it for burning, and also to prevent the disagreeable smell which accompanies the process. The gas furnished in this process, is very similar to that furnished by the distillation of coal. Indeed, there is some analogy in the distillation of animal, vegetable, and mineral coal. In the first, there is ammonia, and a substance having all the properties of tar, but much more fetid, owing to the presence of sulphur, and probably phosphorus; there is also furnished an inflammable gas, which is doubtless carbureted hydrogen mixed with other gases, holding a portion of sulphur and phosphorus.

In the distillation of wood there is no ammonia, but, instead of it, acetic acid. The gas is similar, with the exception of the difference caused by the presence of the sulphur and phosphorus. In the distillation of coal, no acetic acid appears to be formed, but a small portion of carbonate of ammonia: this would show it to be more allied to the animal than the vegetable substance. The gas furnished by coal, is principally the carbureted hydrogen. It contains also a little sulphureted hydrogen, to absorb which, a portion of limewater is used to pass the gas through. The distillation of coal, for the purposes of furnishing gas for the gas-lights, is at present carried on with great advantage, the gas being a valuable substitute for oil and tallow. The coak left in the still, is superior to that made in the common way; and the tar might be used for many purposes, either in the liquid form, or in the state of pitch, which it assumes by evaporation. The residuum from the wood forms excellent charcoal. That from the bones of animals is generally ground down into powder, and sold for ivory black. The coaly residuum from other animal matter, such as hoofs and blood, is used for making Prussian blue. In the distillation of any of these substances, it will be profitable to know, that if the retorts or still, which is of cast iron, be allowed to cool every day, that it will be soon destroyed by the oxygen of the air; but if it be constantly kept at work, by discharging and re-charging it without cooling, the vessels will wear for several years. This will be found a valuable fact to those who have not yet adopted the plan.

Distillation of mercury.

The only means of obtaining mercury in a state of purity, particularly when it is alloyed with other metals, is by distillation. Nothing can answer better for this purpose than an iron retort, having a long tube of the same metal terminating over a vessel of water. The mercury rises at 600° of Fahrenheit, so that a common fire is quite sufficient for the process.

Distillation of phosphorus.

The distillation of phosphorus is attended with more difficulty than almost any other substance. The heat required is considerably above that of a red heat. The retort is required to be of earthen ware. If the substance of the retort be very open, the sublimed phosphorus escapes through it in the state of vapour. If the substance of it be very close, it is in danger of breaking in the bringing up. It is the best, therefore, to make the body a little open, and cover the surface with flint and borax to form a glazing, which prevents the vapour of the phosphorus from escaping. The retort containing the charcoal and the phosphate of lead, should be placed upon a stand in the middle of a small air furnace, the neck passing through an opening in the side. The end of the neck is firmly luted into a glass receiver filled with azotic gas, from whence a small tube passes into a pneumatic apparatus. The fire is raised very gradually. Soon after the retort becomes red hot, the phosphoric acid begins to be decomposed. A portion of water is also decomposed at the same time. The hydrogen unites to a portion of the phosphorus, forming phosphoreted hydrogen gas, which passes through the receiver into the pneumatic trough, along with a large quantity of carbonic acid gas. Ultimately the phosphorus comes over, condenses in the neck of the retort, and runs into the receiver, which contains a little water for its reception. See *Phosphorus* under CHEMISTRY.

Lutes used in distillation.

In most of the processes of distillation, particularly in the small way, substances called lutes are of great importance. When the heat is not much more than boiling water, common flower paste, spread on linen cloth, forms a good lute for uniting the joinings. Linseed meal made into paste with water, is also used in the same way. A paste, made with clay and oil, or common glazier's putty, is very suitable when the heat is not great, as in that case it becomes very soft. The white of egg, or the serum of blood, or skimmed milk made into a paste with lime, forms an excellent lute for all temperatures under 300° of Fahrenheit. In the distillation of oxymuriatic acid gas, bees-wax is sometimes used, but plaster of Paris is much better. This answers very well in the distilling of nitric acid, as it has no action upon it. When the joining is between two glass tubes nearly of the same size, a piece of wet bladder being firmly wrapped round the joining, adheres as it dries, and forms a very secure and permanent lute.

When the juncture is exposed to a red heat, or higher, sand and clay, with a large proportion of the former, answers very well. This will be much improved by a little horse dung worked up with it. If the heat be such as to produce vitrification, a portion of borax or potash may be mixed with the above. See *Description of Chemical Apparatus* under CHEMISTRY.

Different modes of applying the heat.

In different processes of distillation, there are various modes of applying the heat. When violent and sudden heat would be liable to injure the material of distillation, or when accidents might arise from such effect, the sand bath is generally used. If the sand be not a sufficient conductor to bring sufficient heat to the body, it should be mixed with a greater or less proportion of copper or brass filings. When the heat is not required greater than that of boiling water, the retort or still is placed in boiling water, which constitutes what is called a water bath. It will be found more convenient to bring steam from a boiler at a distance, and allow it to condense upon the distilling vessel. If the steam be brought into the interior of a vessel, having on the outside a dished cavity for sand, the steam may be made of greater density than under the common pressure, and by that means give a greater heat than 212°. Indeed, if the steam vessel be provided with a safety valve, any degree of heat short of endangering the vessels may be obtained with great exactness and uniformity.

When the vessels are of metal, if the abrupt heat does not affect the substance, the naked fire may be used. If the vessels be of glass, or earthen ware, then the naked fire would be very liable to crack them, on account of their inferior conducting power, connected with their frangibility. In this case the sand bath, on the application of steam, is very proper. In experiments of the laboratory, the Argand lamp is found the most convenient method of furnishing heat, as well for distillation as for evaporation and other purposes.

The lamp is fixed, capable of sliding upon a standard. Above, and directly over the lamp, is a sliding ring, to support the retort at any distance from the lamp. The lamp being of the Argand kind, admits of any degree of adjustment, by which the heat may be modified, independent of the distance of the retort from the lamp. The greatest advantage of this mode of giving heat, is in its instant application without loss of time, and being able to withdraw the heat at pleasure.

If, instead of the ring for supporting the retort, a vessel open at top and bottom, in the shape of a frustum of a cone, be used, the heat will not only be much economised, but be returned within the sides of the hollow stand. The retort is placed so as to fit the top aperture. The depth of the vessel is half the width at the base. Instead of a glass, as in the Argand lamp, an iron tube is used. (C. S.)

DISTORTION, in *Optics*. See ANAMORPHOSIS.

DISTRESS, (*districtio*,) in English law, in a more common and limited sense, signifies, a taking of moveable goods, profits of lands, or other personal chattel, by way of pledge, for an injury committed by the owner or possessor. It requires no writ, or judicial process, to constitute its legality, and is accordingly ranged by the writers on the law of England, among those methods of redress which are competent by the mere act of the party. The *thing taken* is also, in common language, frequently called a distress.

The injuries for which a distress may be taken are various; but they have been conveniently distributed into five sorts or classes. 1st, The most ordinary sort is that of non-payment of rent, for which a distress is competent to a landlord against his tenant; and, in this respect, it is analogous to the *landlord's hypothec* of the Scotch law. Nor, whatever may have formerly been the rule, is this remedy confined to any particular sort of rent, but is now extended by statute to every description of rent, whether *rent service, rent charge*, or *rent seck*; so that all arrears are alike remediable by the operation of a distress. 2d, For neglecting to do suit to the lord of the manor's court, or other personal service certain, a distress is competent to the lord of common right. 3d, Amercements awarded in a court-leet, but not in a court-baron, (unless by a special prescription,) may be made good by a distress of common right. 4th, Where a man's cattle, or other beasts, stray into his neighbour's grounds, *damage faisant*,---in other words, injuring his pasture, or occasioning other damage, he may *distrain*, or take them in pledge, till satisfaction of the damage. This species of remedy is also competent by the Scotch law, called a *poinding of cattle*. Lastly, there are several duties and penalties created by certain statutes, for the recovery of which, distress, and subsequent sale, is given.

With regard to the sort of property liable to a distress, the general rule is, that all personal chattels are subjected. There are, however, certain exceptions, such as dogs, rabbits, and all other animals *feræ naturæ*, these not being presumable property of the wrong-doer; also the instrument or tool with which a person is actually working, or the horse he is riding, these being privileged for the time, by reason of the personal use or occupation; also whatever is merely in the wrong-doer's possession in the way of trade, as cloth in the dyer's work-house, a horse in a public stable, &c.; also the tools and utensils of a man's trade, beasts of the plough, *averia carucæ*, and sheep, which kinds of property are all privileged by the ancient common law; also whatever is liable to spoil by keeping, as milk, fruit, &c.; and lastly, whatever is fixed to the freehold, as doors, chimney-pieces, &c. although by statute ii. Geo. II. c. 19, growing corn is now subjected.

At common law, whatever was taken by distress, could not be disposed of for satisfaction of the injury, but only retained by way of pledge until replevied, (*replegiare*,) or got back by the wrong-doer, under security of satisfying the distrainer's claim; and thus still stands the law with regard to distresses of beasts taken *damage faisant*. But now by various acts of parliament, all other distresses, if not replevied by the owner within a longer or shorter period as the case may be, may be sold by the distrainer in satisfaction of his claim, and the overplus, if any, restored to the party. (J. B.)

DISTRINGAS, in English law, is a writ, by which the sheriff, or other officer, is commanded to distrain a party in satisfaction of a debt due to the king, or to compel him to some act of obedience to the law.

First, By this process, a party may be compelled to make appearance in the courts of common law, to answer to the plaintiff's suit. If one distress has no effect, the sheriff may proceed from time to time, and continually; and hence it is called a *distress infinite*. By the common law, the goods so taken were forfeited to the king, if the party remained obstinate; but now by statute 10 Geo. III. c. 50, they may be sold, if the court shall so direct, to defray the plaintiff's costs. It is by this process also, that the courts of equity enforce obedience to their summonses or directions against a body corporate, the process of these courts being different in the case of an individual. *Second,* It is likewise used as a compulsive process against jurors, to compel their appearance against the day appointed. And, *third,* Where a defendant has been adjudged to render or do something in special, he may, under this writ, be compelled by repeated distresses of his chattels.

A *distringas* differs from a common *distress* in this, that the one is a judicial process, sanctioned by an express writ; while the other is entirely the act of the injured party. The sole object of the former also, is the redress of a private wrong; while the latter is rather in the way of punishment, for contempt of the authority of the court. (J. B.)

DITASSA, a genus of plants of the class Pentandria, and order Digynia. See Brown, *Wernerian Transactions,* vol. i. and BOTANY, p. 181.

DITMARSH. See DENMARK, and HOLSTEIN.

DITONE, in Music, (III) or Ditonum, $T+t$, is a concordant interval whose ratio is $\frac{4}{5}$, $=197\Sigma+4f+17m$, or the THIRD *Major,* which see.

DITONE of *Aristoxenus,* in his genus Enharmonic, was $\frac{24}{30}$th of the minor fourth, or $\frac{4}{5}\times 4th$, $=203.20471\Sigma+4f+17m$, or $203\frac{1}{5}\Sigma+4f+17\frac{3}{4}m$, and its log. $=.9000490,1071$.

DITONE of *Eratosthenes,* according to Dr Wallis, had a ratio $\frac{15}{19}$, $=208.72902\Sigma+4f+19m$, and its log. $=8973376,5811$. This is the greater of the equal-beating bi-equal thirds of Earl Stanhope. See the *Phil. Mag.* vol. xxvii. p. 203.

DITONE of *Euclid,* was half a major tone less than the minor fourth, or $4th-\frac{1}{2}T$, $=\frac{1}{2}T+t+S$; its ratio is $3^2\div 8\sqrt{2}$, $=202.003931\Sigma+4f+17m$, or $202\Sigma+4f+17\frac{1}{2}m$, and its log. $=.9006375,2462$: it is $=\frac{1}{2}VIII-T$, $=.380076\times VIII$, $=18.41741\times C$.

DITONE, *Double Greater,* (4T) or four major tones, has a ratio $\frac{4096}{6561}$, $=416\Sigma+8f+36m$; it is the SUPERFLUOUS *Fifth* of Bemetzrieder. See that article.

DITONE, *Greatest,* or Ditonus of Holder and others, (2T) or two major tones, has a ratio $\frac{64}{81}$, $=208\Sigma+4f+18m$; it is the *Major* THIRD acute, or COMMA-*redundant,* which see.

DITONE, least of Holder, (2t) or two minor tones, has a ratio $\frac{81}{100}$, $=186\Sigma+4f+16m$: it is the *Major* THIRD grave, or *comma-deficient,* which see.

DITONE, *Semi,* or Sesquitone, (3d) is the least of the concords, if we except the unison, and is said to have been unknown to the ancients before Ptolemy's time; its ratio is $\frac{5}{6}$, $=161\Sigma+3f+14m$. See THIRD *Minor.*

DIU, is the name of an island in the Indian Sea, on the southern coast of Guzzerat. It is about two miles distant from Diu head, the southernmost part of the continent; and is about $6\frac{1}{4}$ miles long from east to west, and $1\frac{1}{2}$ broad from north to south. The channel which separates the island from the mainland, can be navigated only by fishing boats at half tide; and at the western entrance, which is defended by a square fort, there is only four or five feet at low water on the bar.

The island abounds with cattle, poultry, fish, and all sorts of provisions, which are cheaper here than at any of the English stations. There is, however, little fruit, and few vegetables.

The town of Diu is reckoned one of the best built, and one of the strongest cities in India. The streets are extremely narrow, but are kept very clean. The houses within the walls are of free-stone, and some of them, inhabited by Banians, are four or five stories high. The town contains several churches and convents. The castle of Diu is defended with more than 100 pieces of mounted cannon, several of which are of brass; and from the castle there extends a wall, with half-moon towers at equal intervals, and encircling the whole town. The sea gate and the land gate are always shut at sun-set. Opposite to the custom-house is a flight of stone steps, which form the landing place, and here are many shops and warehouses. Vegetables are brought to Diu from the mainland in great abundance; but beef is procured clandestinely, as the principal merchants are Hindoos. The water on the island is brackish. The rain water is kept in large reservoirs, and will last from one season to another. It is conveyed to the wharf in a canal, and delivered to the boats from a cock. Within 500 yards of the east side of the castle, there is water sufficient for a 74 gun ship.

In consequence of the bad conduct of the Portuguese, the immense trade which was formerly carried on at Diu has been transferred to Surat and other adjacent places. Tavernier, in his *Observations sur le Commerce des Indes,* considers Diu as one of the finest stations in the East for a great commercial establishment, from the safety of its harbour, the excellence of its water, the extraordinary quantity which it affords of all sorts of refreshments, and from its proximity to Surat, which can be reached in four or five days.

At Nowabunder, about five miles to the east of Diu, there is a nest of pirates, who keep their vessels in a small creek, protected by a little fort. They, however, spare all boats under Portuguese colours.

In the year 1509, when Albuquerque, at the head of the Portuguese, first visited Diu, he described the city as a grand and spacious place, girt with strong walls and lofty towers, all handsomely built and well laid out, like towns in Portugal. He attacked the shipping in the harbour, amounting to 200 sail, and took or sunk the greater part of them. Albuquerque, however, was induced to abandon his plan of attacking Diu; and having made an advantageous peace, he returned southward. After many attempts to get a fort erected in Diu, the Portuguese at last obtained permission, in 1534, from Badur, King of Cambaye, and they completed it in the short space of 49 days, and mounted 60 pieces of cannon upon the ramparts. Badur, however, repented of his concession, and began to build a wall or fortification between the fort and the city, which he was obliged to give up after strong remonstrances from the Portuguese.

In the year 1537, Badur made a treacherous attack upon Diu, slew De Sousa, the commandant of the fort, during a friendly interview, but lost his own life in the affray which ensued. The town of Diu was immediately surrendered to the Portuguese. They found only 200,000 pardaos (L.37,500 sterling), but the quantity of ammunition was immense. They obtained a prodigious number of brass cannon, among which were three basilisks of enormous size, one of which was sent by De Cuna as a curiosity to Lisbon, and was placed in the castle of St Julien, at the mouth of the Tagus, where it is known by the name of the great gun of Diu.

In the year 1538, the Turks, aided by the king of Guzzerat, made a desperate attempt upon Diu; but the Governor Silveira, conducted the defence in a stile of bravery and skill, which has perhaps never been surpassed in the annals of war. The acts of heroism and personal valour which were displayed during the siege, both by the men and the women of the garrison, would give splendour to the brightest page of history. The following account of this event is too interesting to require any apology:—"Hearing that the Turkish fleet was approaching, Sylveira sent immediate notice of it to Nuno de Cuna, who prepared with great diligence to go in person to relieve Diu. Michael Vas was sent to sea by Sylveira to look out for the enemy, and falling in with their fleet, came so near, on purpose to examine their force, that several of their shot reached his vessel. He got off however, and carried the news to the governor of Goa. The Turkish fleet came at length to anchor in the port of Diu, where it was formidable not only to the small Portuguese garrison in the fort, but to the Moors even who had long expected their arrival. Next day Solyman landed 600 well armed janizaries, who immediately entered the city and behaved with much insolence. Drawing near the fort, they killed six Portuguese; but 300 musqueteers attacked them from the fort, and drove them away with the loss of 50 men. In consequence of a storm, Solyman was obliged to remove his fleet to Madrefavat, as a safer harbour, where he remained 20 days, during which time Sylveira was diligently occupied in strengthening the fortifications of the castle, planting his artillery on the ramparts, and assigning every one his proper post for the ensuing siege. At the same time, the Turks assisted by Zofar, (one of the retinue of Badur who escaped from the affray of 1537,) commenced operations against the fort, by constructing batteries, and endeavouring to ruin the defences of a bulwark at the entrance of the harbour, which they battered with their cannon. With this view, likewise, they built a wooden castle on a large bark, which they filled with combustibles, meaning to send it against the bulwark to set it on fire. But Francisco de Gouvea, who commanded the small naval force then at Diu, went against this floating castle under night, and contrived to destroy it by fire. At this time, likewise, some relief was sent to the fort by Nuno de Cuna, and the garrison was much elated by the assurance of his intention of coming speedily in person to raise the siege.

Returning from Madrefavat, Solyman commenced a heavy fire from his ships against the sea bulwark in which Francisco de Gouvea commanded, but was so well answered, both from that work and the tower of St Thomas, that one of his gallies was sunk and most of her men drowned. The greatest harm suffered at this time by the Portuguese was from the bursting of some of their own cannon, by which several men were killed. Two brothers only were slain by the fire of the Turks. Zofar now so furiously battered the bulwark in which Pacheco commanded, that it became altogether indefensible, on which 700 janizaries assaulted it, and set up their colours on its ruined walls; but the Portuguese rallied and dislodged them, killing an hundred and fifty of the enemy. The assault of this bulwark was continued a whole day, and at night the enemy were forced to retreat with much loss. Next day Pacheco deeming it impossible to resist, surrendered upon promise of life and liberty to himself and his men. Solyman did not perform the latter stipulation, but he granted their lives for the present, and clothed them in Turkish habits. By one of these prisoners, Solyman sent a summons to Sylveira to surrender, but the proposal was treated with contempt. Solyman now planted his artillery against the fort, having, among other cannon, nine pieces of vast size, which carried balls of ninety pounds weight. His artillery in all exceeded 130 pieces of different sizes, and his batteries were continually guarded by 2000 Turks. This formidable train began to play against the castle on the 4th of October 1538, and continued without cessation for 20 days, doing great injury to the defences of the fort, which could hardly do any mischief in return to the besiegers, neither could the garrison repair sufficiently the most dangerous breaches, though they used every possible exertion for that purpose. On the sixth day after the commencement of this violent cannonade, perceiving that the bulwark commanded by Gaspar de Sousa was much damaged, the Turks endeavoured to carry it by assault, but were repulsed with much slaughter, two only of the defenders being slain. Every day there were assaults by the besiegers, or sallies by the garrison. In one of these, Gonzalo Falcam lost his head; and Juan de Fonseca, being disabled by a severe wound of his right arm, continued to wield his lance with his left as if he had received no hurt. A youth of only nineteen years old, named Joam Gallego, pursued a Moor into the sea and slew him, and afterwards walked back deliberately to the fort through showers of balls and bullets. Many singular acts of valour were performed during this memorable siege.

At length many brave officers and men of the besiegers were slain, powder began to wax short, and provisions shorter. The relief expected from Non Garcia Noronha, now come out as viceroy of India, was long in making its appearance. The remaining garrison was much weakened by a swelling in their gums, accompanied by their teeth becoming so loose that they were unable to eat what little food remained in the stores. Yet the brave garrison continued to fight in defence of their post, as if even misery and famine were unable to conquer them. Even the women in the fort exerted themselves like heroines. Donna Isabella de Vega, the wife of Manuel de Vasconcelles, had been urged by her husband to go to her father Francisco Ferram at Goa, lest the fort might be taken and she might fall into the hands of the Turks; but she refused to leave him. During the distress of the garrison, as many of the men were obliged to work in repairing the works, this bold-spirited lady called together all the women who were in the fort, and exhorted them to undertake this labour, as by that means all the men would be enabled to stand to their arms. The women consented to this proposal, and continued for the remainder of the siege to perform this duty. She was even outdone by Ann Fernandez, the wife of a physician, who used to visit the most dangerous posts by night, and even appeared at the assault to encourage the soldiers. Her son happening to be slain in one of the attacks, she immediately drew away his body, and returned to the place of danger, and when the fight ended she went and buried her son.

Perceiving that the Turks were undermining the bulwark which he commanded, Gasper de Sousa made a sally with seventy men to prevent that work, and made a great slaughter of the enemy. When retreating he missed two of his men, and returned to rescue them; but, being surrounded by the enemy, they cut the tendons of his hams, after which he fought upon his knees till he was overpowered and slain. The mine was countermined; but the continual labour to which the besieged were subjected became insupportable, and they were utterly unable to repair the many breaches in their works. At this conjuncture, four vessels arrived from the viceroy Don Garcia, and landed only a reinforcement of twenty men. Solyman was much concerned at this relief though small, and was astonished that the fort should hold out against so many assaults, more especially as Zofar had assured him he might carry it in two. At the beginning of the siege the garrison consisted of 600 men, many of whom were slain, and several of the cannon belonging to the fort had burst; yet Solyman began to lose confidence, and looked anxiously to the sea, fearful of the Portuguese fleet which he had learnt was coming against him. This induced him to press the siege more vigorously, especially against the sea bulwark where Antonio de Sousa commanded, which was furiously attacked by fifty barks, two of which were sunk by the Portuguese cannon. The Turks made several attempts to scale this bulwark, in all of which they were repulsed with great slaughter, yet returned repeatedly to the charge with similar bad fortune. Sousa sent off his wounded men from the rampart to have their wounds dressed. Among these was a person named Fernando Ponteado, who, waiting his turn, heard the noise of a fresh assault, and, forgetting the dressing, ran immediately to his post, where he received a fresh wound. Going back to get dressed, a third assault recalled him before the surgeon had time to attend to his wants, and he was a third time wounded, and at length returned to get all his three wounds dressed at once.

By this time, out of the original garrison of 600 men, only 250 remained that were able to stand to their arms. Solyman was almost in despair of success, yet resolved to make a desperate effort to carry the place. In hopes of putting Sylveira off his guard, and to take the place by surprise, he sent twelve of his gallies to sea, as if he meant to raise the siege; but Sylveira was not to be lulled into security, and continued to exert the utmost vigilance to provide against every danger. One night some noise was heard at the foot of the sea-wall of the castle, where it appeared that the enemy were applying great numbers of scaling ladders. Every effort was made to oppose them during the darkness of the night, and when morning broke, the place was seen beset all round by at least 14,000 men. The cannon of the fort was immediately directed against the assailants, and the garrison mounted the walls in every part, but chiefly near the governor's house, where the defences were weakest, but where Sylveira had placed such people as he could most rely upon. Being repulsed from thence with great slaughter, the enemy made an attempt on an adjoining bulwark, where Gouvea commanded, and poured in prodigious showers of bullets and arrows. Fourteen gallies came up against this bulwark, which they battered with their cannon; but Gouvea obliged them to draw off, having sunk two of the gallies, and killed many of their crews. At length 200 Turks forced their way into the bulwark, and planted their colours on its rampart. Scarcely thirty Portuguese remained to oppose them, yet they charged the enemy with great fury, who were so thick that every shot told, and they were driven out with much loss. Fresh men succeeded and regained the bulwark, on which they planted four standards. Many of the Portuguese, who were wounded and burnt by the fire-works of the enemy, ran and dipped themselves in jars of salt water, where, seeking ease, they perished in dreadful torment.

Sylveira went continually from place to place, encouraging all to do their duty manfully, and supplying reinforcements where they were most needed. The enemy had much the better in the second assault on the bulwark commanded by Gouvea, on which several gentlemen rushed upon them. At this time one Joam Rodrigues, a strong man of great bravery, ran forward with a barrel of powder on his shoulder, calling out to clear the way, as he carried his own death and that of many. He threw the barrel among the enemy, which exploded, and blew up above 100 of them; yet Rodrigues came off unhurt, and performed other memorable deeds, so that he merited the highest honours and rewards of those that were gained in this siege. By other fire-works, the four ensigns who set up the colours were burnt to death, and two others who went to succeed them were slain. Being again driven from the bulwark, the enemy made a third assault: But their commander being slain, who was son-in-law to Khojah Zofar, his men were dismayed and took to flight. These reiterated assaults lasted four hours, during which a small number of exhausted Portuguese had to withstand vast numbers of fresh enemies. At length, having 500 men slain and 1000 wounded, the enemy retired; while on the side of the Portuguese 14 were killed, and 200 were disabled from wounds. Only 40 remained who were able to wield their arms, insomuch that no hope remained of being able to withstand a fresh attack. The walls were shattered and ruined in every part: No powder remained: In fact, nothing was left but the invincible courage of Sylveira, who still encouraged the remnant of his brave garrison to persist in their defence. Not knowing the desperate state to which the fort was reduced, and dismayed by the bad success of all his efforts, Solyman raised the siege, and set sail with all his fleet on the 5th of November."

With the exception of another unsuccessful attempt in 1545, the Portuguese enjoyed the peaceful possession of Diu till 1670, when the Muscat Arabs took the city by surprise, and filled three vessels with the immense plunder which they collected. By mounting some cannon on a church, they attempted to destroy the fort; but though the Portuguese were prevented by the priests from firing at the church, the Arabs were unable to make any impression. Having become negligent and oversecure, the Portuguese took advantage of it; and sallying from the castle, they slew 1000 Arabs, and forced the remainder to abandon the city, and seek for shelter in their vessels. Since that time, Diu has never recovered from the evils which the Arabs inflicted upon it.

The population of Diu is about 40,000, only 200 of whom are Portuguese, the rest being Banians, Persees, and Moors. The position of Diu Head is in East Long. 71° 7′, and North Lat. 20° 42′. See Manuel de Faria's *Asia Portuguesa*, a translation of which will be found in Astley's *Collection of Voyages and Travels*, vol. i. p. 58; and in Kerr's *Collection of Voyages and Travels*, vol. vi. p. 69. See also Milburn's *Oriental Commerce*, vol. i. p. 151. (*j*)

DIVERGENCY of *Tune*. M. Huygens and M. Sauveur have both treated on the deviation from the pitch first assumed, which singers experience in singing certain passages or successions of intervals in perfect tune; owing to the want of that necessary or exact connection between melody and harmony, which the modern theories of music have assumed. Mr Maxwell, in his "Essay upon Tune," has considered the causes of this divergency, and has directed violin performers how to avoid its effects, in passages which Composers, unacquainted with this theory, have left in their works. Mr Liston has shewn, in his "Essay on perfect Intonation," how this divergency may be corrected in an almost insensible manner, or avoided, or managed at pleasure, by the peformers on his euharmonic organ, by what he calls ENHARMONIC *Changes*, which see.

DIVERS. See DIVING.

DIVICOTTA, or DEVYCOTTA, is the name of a fort in Hindostan, situated on a small island within the entrance of Coleroon river. It is built of brick, and is very strong. It was taken in 1749 by the English under Major Lawrence, from the rajah of Tanjore. As there is sufficient water for large ships within the bar, the East India Company proposed to form this place into a harbour, and with this view they obtained from the rajah the cession of a district. This plan, however, has been long ago abandoned. The four famous pagodas, called the Chalanbaran Pagodas, are to be seen up the country. North Lat. 11° 22′. See Milburn's *Oriental Commerce*, vol. i. (*j*)

DIVIDEND has, in arithmetic, the general signification of "any number given to be divided;" in commerce, it has two significations, of very frequent occurrence, viz. the "share obtained by a creditor out of a bankrupt estate," and the "money paid as the interest or return of capital invested in a public fund." In the latter, the times of payment are generally half yearly; and though, strictly speaking, the amount in all joint stock companies ought to fluctuate with the profits of the concern, it has been found more advisable to adopt an average rate, and to adhere to it as nearly as possible, for the sake of preventing uncertainty and agitation to the body of stock-holders. The West India Dock, and London Dock Companies, for example, have adhered, with little variation, to the dividends with which they respectively set out. The India Company, having at one time raised their dividend to 10 per cent. have thought proper to continue it at that rate; and a similar rule has been adopted by the Bank of England for a number of years, subject, however, to the prospect of reduction on the resumption of cash payments. But of all dividends, the most familiar to the public at large are the payments made by government to stock-holders, in discharge of the interest of the national debt. These take place half yearly, and principally in the months of January and July, April and October. It is customary to begin by making the payments to the London bankers, who receive very large sums as agents for stock-holders living at a distance from the Bank. The issue to the bankers has the effect of throwing a great deal of money directly into circulation; after which, in the course of a few days, payments are made to all private individuals, who choose to call at the Bank for the half year's interest of stock belonging either to themselves, or to those for whom they are empowered to act. The books containing the names of the stock-holders are numerous, and, on entering the offices at the Bank, the eye is directed to the proper clerks by the initial letters being painted conspicuously against the wall. Before issuing the dividends, it is necessary to take some time to post the bank-books in the names of the last holders of the stock, as changes are perpetually occurring in a property so easily transferable. During this interval, the transfer books are said to be "shut;" that is, no transfers can be regularly entered in them, till after payment of the dividends.

In consequence of deaths and absence from the country, there occur frequent omissions in calling for accrued dividends. The amount thus remaining unpaid, having, about the year 1790, become very considerable, it was determined to publish the names of the proprietors of the stock in question, and afterwards to appropriate the balance to the public use, until it should be called for by the parties entitled to it. The sum thus taken over by government was at first £376,739; and, in 1808, a farther sum of half a million was, in like manner, paid into the Exchequer by the Bank; a provision, however, being made, that the balance of unclaimed dividends remaining in the hands of the Bank, should not at any time be reduced below £100,000.

It was in the beginning of the present war, that the property tax was first deducted from the stock-holder, before making payment of the dividend. An idea was at one time general, that the interest of all money lent to government, should be paid free of any tax or deduction whatever; but the ardour of the public for war against Bonaparte, enabled ministers to act on a different interpretation of the law; so that the only dividends exempt from the operation of the property tax, are those which are payable to foreigners. Attempts have even been made in the House of Commons, to procure an act subjecting the latter, like ourselves, to a deduction on the score of property tax; but government have thought it advisable to wave this limited advantage, in consideration of the impolicy of discouraging the investment of foreign capital in our funds. (*x*)

DIVIDING OF INSTRUMENTS. See GRADUATION.

GENERAL EXPLANATION

OF THE

PLATES BELONGING TO VOLUME SEVENTH

OF THE

EDINBURGH ENCYCLOPÆDIA.

PLATE CCIII.

Fig. 1. Nautilus Beccarii. *Magnified.* A spiral Shell, with the cavity divided into chambers.
a, One of the chambers.
b, The partition.

Fig. 2. Helix Paludosa. A spiral Shell, with an undivided or unilocular cavity.

Fig. 3. Orthocera Recta. *Magnified.*
a, The outside.
b, a section, which exhibits the chambers.

Fig. 4. Dentalium Gadus. *Magnified.* An unilocular tubular Shell.

Fig. 5. Odostomia Muscorum. *Mag.* Spires *dextral.*

Fig. 6. Odostomia Laminata. Spires *sinistral.*

Fig. 7. Murex Corneus. Divided, in order to exhibit the *pillar* round which the spires revolve.
a, The pillar.
b, The mouth.
c, The canal in which the cavity of the mouth terminates.

Fig. 8. Planorbis Complanatus. Divided, the spires lateral, and destitute of a pillar.

Fig. 9. Helix Margarita.
a, The operculum or lid.

Fig. 10. Turbo Elegans.
a, The operculum rayed.

Fig. 11. Turbo Disjunctus.
a, Spires very distinctly separated.

Fig. 12. Buccinum Reticulatum.
a, Outer lip denticulated.

Fig. 13. Voluta Triplicata.
a, The pillar lip plaited.

Fig. 14. Helix Lævigata. With the epidermis.

Fig. 15. —— ———. Epidermis removed.

Fig. 16. Nerita Glaucina.
a, The pillar cavity.

Fig. 17. Nerita Canrena.
a, The pillar cavity grooved.

Fig. 18. Pectunculus Pilosus.
a, The crenulated margin.
b, The teeth of the hinge.
c, The ligament.
d, The beak.

Fig. 19. Venus Decussata.
a, The broad border line approaching the middle of the Shell.
b, The ligament.
cc, The cicatrix.

Fig. 20. Venus Pullastra.
a, The fold of the border line, nearer to the margin than in Venus Decussata.
b, The ligament.
c, The cicatrix.

Fig. 21. Solen Marginatus.

a, The external ligament.
b, the gape.

Fig. 22. Mytilus Modiolus. Young shell.
a, The longitudinal furrow of the hinge destitute of teeth.

Fig. 23. Tellina Radula.
a, The base.
b, The anterior margin.
c, Posterior margin.
d, Superior margin.
f, The right valve.
g, The left valve.

Fig. 24. Lepas Anatifera.
a, The peduncle.
b, The connecting ligament.
c, The base.

Fig. 25. Balanus Punctatus. An articulated Shell.
a, The accessory valves.

PLATE CCIV.

Fig. 1. Patella Cœrulea.
a, The young shell.
Fig. 2. ——— Elongata.
Fig. 3. ——— Elliptica.
Fig. 4. ——— Distorta.
Fig. 5. ——— Zetlandica.
Fig. 6. ——— Marginata.
Fig. 7. Cæcum Glabrum.
Fig. 8. Serpula Serrulata.
Fig. 9. ——— Tubularia.
Fig. 10. Lagena Globosa.
Fig. 11. ——— Perlucida.
Fig. 12. ——— Urnæ.
Fig. 13. Spirorbis Carinatus.

PLATE CCV.

Fig. 1. Spirorbis Heterostrophu
Fig. 2. ——— Minutus.
Fig. 3. ——— Conicus.
Fig. 4. ——— Lucidus.
Fig. 5. Murex Rufus.
Fig. 6. Turbo Auricularia.
Fig. 7. Helix Hortensis, with the margin of the mouth white.
Fig. 8. Serpula recta anfractibus tribus contiguis regulariter involutis of Mr Walker, *Test. Min. Rar.* tab. 1. fig. 11.
Fig. 9. Serpula recta umbilico pervio anfractu apicis unico involuto of Mr Walker, *Test. Min. Rar.* tab. 1. fig. 12.
Fig. 10. Turbo Elegantissimus. Shell glossy, white, with thirteen spires, longitudinally ribbed; aperture suborbicular; inner lip a little reflected; length scarcely three-eighths. Not uncommon in England; rare in Scotland.
Fig. 11. Miliola Lactea. Shell pellucid, smooth, thin, egg-shaped, with milky veins. In England and Scotland rare.
Fig. 12. Pecten Subauricula.
Fig. 13. Mactra Solida.
Fig. 14. ——— Truncata.
Fig. 15. ——— Subtruncata.

PLATE CCVI.

Fig. 1. Venus Reflexa.
Fig. 2. Terebratula Vitrea.
Fig. 3. Pinna Ingens.
a, The byssus.
Fig. 4. Turbo Scalaris, or Wentle-trap, of an uncommon size, and great value. From the Museum of Mr Bullock.

PLATE CCVII.

Contains Diagrams for illustrating the article CONIC SECTIONS.

PLATE CCVIII.

Contains Diagrams for illustrating the article CONIC SECTIONS.

PLATE CCIX.

Contains Diagrams for illustrating the article CONIC SECTIONS.

PLATE CCX.

Contains Diagrams for illustrating the article CONIC SECTIONS.

PLATE CCXI.

Contains Diagrams for illustrating the article CONIC SECTIONS.

PLATE CCXII.

Fig. 1. Represents the Roller Gin, on a new construction for separating the gins, or seeds, from the cotton.
Fig. 2. Is a representation of the Saw Gin, for the same purpose.
Fig. 3. Represents the Centrifugal Cotton Picker, for cleaning cotton.
Fig 4. Represents an improved Batting Machine, for preparing the cotton.
Fig. 5. Is a horizontal plan of a New Diagonal Mule for spinning cotton, invented by Mr John Duncan of Glasgow.
Fig. 6. Is a Perspective Representation of the same Machine.

PLATE CCXIII.

Fig. 1. Shews part of the Boards of a Pair of Hand-cards.
Fig. 2. Shews the Form of one of the Wires stuck through the leather.
Fig. 3. Is a Vertical Section of the Breaker used in carding cotton.
Fig. 4. No. 1. and 2. Represent a Front View and Plan of the Taker-off and the Finisher.

Fig. 5. Is a Vertical Section of the Finisher.
Fig. 6. Represents the Fast and Loose Pullies for throwing into action and disengaging the machinery.
Fig. 7. Represents a Pair of Rollers for drawing the cotton.
Fig. 8. Represents one Head of a Drawing Frame.

PLATE CCXIV.

Fig. 1. Represents one head of a Drawing Frame.
Fig. 2. Is a view of the Can Roving Frame.
Fig. 3. Represents the Jack Frame.
Fig. 4. Is a view of the Spindle and Flyer Roving Frame.
Fig. 5. Is a Profile of one head of the Water Spinning Frame.
Fig. 6. Represents another Spinning Frame, called the Throstle.
Fig. 7. Shews the Reel for winding up the Cotton into Hanks, &c.
Fig. 8. Represents the method of Mule Spinning.

PLATE CCXV.

Fig. 1. Is a representation of one of the Hydrostatic Cranes, invented by Mr Bramah.
Fig. 2. Represents another of Mr Bramah's Hydrostatic Cranes, for raising weights to a small height.
Fig. 3. Is a view of the Safety Valve of the Crane.
Fig. 4. Represents the inclined Walking Wheel Crane, invented by Mr James White of Chevening, in Kent.
Fig. 5. Is a view of the New Crane, invented by Mr Gilbert Gilpin.
Figs. 6, 7, and 8. Contain a separate representation of some of the most important parts of Mr Gilpin's Crane.
Fig. 9. Represents Mr Kier's Moveable Crane, which was employed in the erection of Ramsgate Pier.
Fig. 10, and 11. Contain two views of the Lowering Cylinder, invented by Mr Hardie.

PLATE CCXVI.

Fig. 1. Represents a small Crane, made of cast iron.
Fig. 2. Is a similar Crane, but of greater strength and power.
Fig. 3, and 4. Are side and front elevations of another iron Crane.
Fig. 5. Is another iron Crane of a different construction.
Fig. 6. Represents an iron Crane suitable for an iron foundery.

PLATE CCXVII.

Fig. 1, 2, and 3. Represent a side and back view of the Crane erected on the Grand Junction Canal at Paddington.
Fig. 4. Shews a transverse view of the Crane used for constructing the Breakwater at Aberdeen harbour.
Fig. 5. Is a Longitudinal view of the Crane.
Fig. 6. Is a plan of the Crane with Waggons and Railways.
Fig. 7. Is an enlarged view of the Sliding Carriage.
Fig. 8. Is a Plan of the Sliding Carriage.

PLATE CCXVIII.

Fig. 1. Represents the Facial Angle of Camper in the Skull of a Negro.
Fig. 2. Is the Inferior Basifacial line of Dr Barclay, on the Skull of the *Babirossa Vulgaris.*
Fig. 3. Is the Skull of a Negress from the coast of Guinea.
Fig. 4. Represents the Skull of a Georgian Female.
Fig. 5. Is the Skull of a Tungoose.
Fig. 6. Represents the Craniometer invented by Dr Barclay, for measuring the various diameters of the Cranium.
Fig. 7. Shews the Craniometer invented by Dr W. E. Leach of the British Museum, for measuring the Inferior Basifacial angle of Dr Barclay.

PLATE CCXIX.

Figs. 1, and 2. Represent a Profile elevation of the Common Linau, or Gauze Loom.
Figs. 3, and 4. Represent the Machinery of Crossed Texture, where the twist is carried one half farther than in common linau or gauze, that is of open and crossed catgut.
Fig. 5. and 6. Represent the open and crossed Whip-net.
Fig. 7. Represents the Patent Net open.
Fig. 8. Shews the Patent Net crossed and finished.
Fig. 9. Is a representation of the Patent Draw Loom, described under the Article CLOTH MANUFACTURE, p. 690.

PLATE CCXX.

Figs. 1, 2, and 3. Represent the Apparatus for Weaving the Russia Table Rubber.
Fig 1. Is the Front Elevation of the Loom.
Fig. 2. Is the Profile Elevation.
Fig. 3. Is a general Plan for representing each successive stage of the Operation of the Lams.
Figs. 4, 5, 6, and 7. Represent Looms for Weaving goods called Lappets.

PLATE CCXXI.

Contains a representation of Crustaceous Animals.
Fig. 1. Limulus Polyphemus.
Fig. 2. Cypris Reniformis.
Fig. 3. Pinnotheres Pisum.
Fig. 4. Leptopodia Phalangium.
Fig. 5. Crangon Vulgaris.
Fig. 6. Orchestia Littorea.
Fig. 7. Idotea Entomon.
Fig. 8. Ligia Oceanica.

Fig. 9. Julus, an exotic species, to shew the character of the genus.
Fig. 10. Scolopendra of that family with alternate joints.
Fig. 11. Pycnogonum Balænarum.
Fig. 12. Aranea Parietina.

PLATE CCXXII.

Contains twenty-one Diagrams for illustrating the Mathematical Theory of Crystals.

PLATE CCXXIII.

Contains thirty-eight Diagrams for illustrating the Mathematical Theory of Crystals.
Fig. 34. Represents the Goniometer used by Romé de Lisle and Hauy for Measuring the Angles of crystals.

PLATE CCXXIV.

Fig. 1. Represents the Reflective Goniometer invented by Dr Wollaston for Measuring the Angles of Crystals.
Fig. 2. Represents the Reflecting Goniometer invented by Dr Brewster.
Fig. 3—25. Are Diagrams for illustrating the Mathematical Theory of Crystals.

PLATE CCXXV.

Fig. 1—8. Are Diagrams for illustrating the Mathematical Theory of Crystals.
Fig. 9. Is the primitive form of Leucite or Amphigene.
Fig. 10. Analcime, or Cubizite.
Fig. 11. Sulphate of Magnesia.
Fig. 12. Vesuvian, or Idocrase.
Fig. 13. Meionite.
Fig. 14. Mesotype, or Radiated Zeolite.
Fig. 15. *Id.*
Fig. 16. Chrysoberyl, or Cymophane.
Fig. 17, 18. Chrysolite, or Peridot.
Fig. 19. Stilbite, or Foliated Zeolite.
Fig. 20. Prehnite.
Fig. 21. Wolfram.
Fig. 22. Sulphate of Barytes.
Fig. 23. Sulphate of Strontian.
Fig. 24. Granatite, or Staurotide.
Fig. 25. Talc.
Fig. 26. Arsenical Pyrites, or Mispickel.
Fig. 27. Gypsum, or Sulphate of Lime.

PLATE CCXXVI.

Fig. 1, 2. Pistazite Epidote, or Zoisite.
Fig. 3. Axinite, or Thummerstone.
Fig. 4. Amphibole, Hornblende, Actinolyte, Grammatite, and Tremolite.
Fig. 5. Augite or Pyroxene, Coccolite, Diopside, and Salite.
Fig. 6. Felspar.
Fig. 7. Cyanite, or Disthene.
Fig. 8, 9. Sulphate of Copper.
Fig. 10. Carbonate of Lime, Equiaxe of Hauy.
Fig. 11. Ditto, Inverse of Hauy.
Fig. 12. Ditto, Metastatic of Hauy.
Fig. 13. Ditto, Contrasting of Hauy.
Fig. 14. Ditto, Regular Six-sided Prism.
Fig. 15. Quartz.
Fig. 16. Tourmaline, or Schorle.
Fig. 17. Oligiste, or Glance Iron ore.
Fig. 18. Apatite.
Fig. 19. Nepheline, or Sommite.
Fig. 20. Garnet.
Fig. 21. Diamond.
Fig. 22. Topaz.
Fig. 23. Calamine.
Fig. 24, 25. Zircon.
Fig. 26. Harmotome, Cross stone, or Staurolite.
Fig. 27, 28. Molybdate of Lead.
Fig. 29. Common form of Anatose, or Octahedrite.
Fig. 30. Primitive form of Carbonate of Soda.
Fig. 31. Common form of Carbonate of Soda.

PLATE CCXXVII.

Fig. 1. Is a perspective representation of a Draw-loom, adapted for Damask Tweeling.
Fig. 2—16. Are various Diagrams for illustrating the Theory of Curve Lines and Surfaces.

PLATE CCXXVIII.

Fig. 1. Is the representation of an Ancient Dial found in 1741, in the Ruins of a Roman House in Tusculum, and supposed to have belonged to Cicero.
Fig. 2. Is a very curious Portable and Ancient Dial, dug out of the ruins of Portici in 1755.
Fig. 3. Is a Diagram for illustrating the general principles of Dialling.
Fig. 4 and 5. Shew the method of Tracing a Meridian Line from Three Shadows of a Stile.
Fig. 6. Shews the method of transferring the Meridian Line to any place.
Fig. 7. Represents an Universal Equinoctial Dial.
Fig. 8. Is a perspective representation of an Horizontal Dial.
Fig. 9. Shews the method of constructing a Horizontal Dial.
Fig. 10. and 11. Shew a geometrical method of constructing Horizontal Dials.
Fig. 12. Illustrates another geometrical method of constructing Horizontal Dials.
Fig. 13. Shews the method of constructing Dialling Scales.
Fig. 14. Shews the method of constructing Horizontal Dials by Dialling Scales.
Fig. 15. Points out the method of constructing Horizontal Dials, by means of a Globe.
Fig. 16. Is a Vertical South Dial.
Fig. 17. Is a Vertical North Dial.
Fig. 18. Diagram for explaining the nature of Vertical East and West Dials.

PLATE CCXXIX.

Fig. 1. Represents an East Dial.
Fig. 2. Represents a West Dial.

Fig. 3. Is the form of the Stile for East and West Dials.
Fig. 4. Represents a Polar Dial.
Fig. 6. Is a Diagram for explaining Vertical Declining Dials.
Fig. 6. Represents a Vertical South Dial declining to the West.
Fig. 7. Represents a Vertical South Dial declining to the East.
Fig. 8. Is a Diagram shewing how to construct a Declining Dial, by considering it as a Horizontal Dial for some other place.
Fig. 9. Is a Diagram shewing how to find the Declination of a plane.
Fig. 10, 11. Are Diagrams explaining the theory of Inclining Dials.
Fig. 12. Represents an Inclining Dial.
Fig. 13, 14. Are Diagrams shewing how to find the path described on a plane by the extremity of a Shadow.
Fig. 15. Is a Diagram explaining the Retrogradation of the Shadow on particular Dials.
Fig. 16. Explains the theory of Dials with Variable Centres.
Fig. 17. Represents a Dial with a Variable Centre.

PLATE CCXXX.

Fig. 1. Shews the geometrical construction of an Analemmatic or Azimuth Dial.
Fig. 2. Represents a Dial which sets itself, being composed of an Analemmatic and a Horizontal Dial.
Fig. 3. Represents Lambert's Dial.
Fig. 4. Shews how to construct a Portable Dial on a Card.
Fig. 5. Represents a Portable Dial on a Card.
Fig. 6. Represents a Dial on the surface of a Cylinder.
Fig. 7. Shews how to construct the preceding Dial.
Fig. 8, 9, 10. Shew the construction of a Ring Dial.
Fig. 11, 12. Represent an Universal Dial on a Cross, and the method of constructing it.
Fi . 13. 14. Represent Ferguson's Universal Dial which shews the hour by the Terrestrial Globe and by several Gnomons at the same time.
Fig. 15. Represents a Vertical South Dial, with the Babylonian Hours.

END OF VOLUME SEVENTH.

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